

Overview

MacBook Pro (15-inch, 2016 and 2017)



What's New

The MacBook Pro (15-inch, 2017) features:

- **Processor:** 2.8GHz, 2.9GHz, or 3.1GHz Intel quad-core i7 processors

The MacBook Pro (15-inch, 2016) features:

- **Processor:** 2.6GHz, 2.7GHz, or 2.9GHz Intel quad-core i7 processors

Both the 2016 and 2017 models feature:

- **Retina Display:** 15.4-inch (diagonal) Retina display with higher efficiency LEDs
- **Memory:** 16GB onboard, not user installable
- **Storage:** 256GB, 512GB, 1TB, 2TB onboard flash storage.
- **Graphics:** Radeon Pro Graphics (Discrete Graphics)
- **Touch Bar:** Touch-based dynamic function row

- **Touch ID:** Power button and Apple Pay

Diagnostics:

- Apple Service Toolkit version 2 (AST 2)
- The [Trackpad Calibration Check](#) must be performed after every repair

For product configurations, refer to Tech Specs at support.apple.com/specs/#macbookpro.

Important Service Considerations

This computer model's design requires special service considerations:

- **Important:** This computer should only be repaired by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- **Startup and Power:** There is no startup sound. Boot on Lid Open and Boot on AC Attach are two features that automatically power on the system. These features must be disabled prior to any repair that involves removing the bottom case. After the repair is complete, these features must be re-enabled. Refer to article [TP1484: Auto Boot](#).
- **Bottom Case:** The bottom case must be serviced with the bottom case removal/install fixture kit (076-00290)
- **Battery Safety:** Before beginning any repair procedure, install the battery cover and disconnect the battery cable from the logic board.
- **Battery Service:** The battery is not a replaceable part. Never remove the battery from the top case. To replace a battery, you must replace the top case.
- **Logic Board and Touch ID:** The logic board and Touch ID board are paired. When one is replaced the other must also be replaced.
- **Touch ID:** The Touch ID board requires a special tool for reassembly, Touch ID alignment tool (923-01586).
- **Top Case:** The top case comes with the battery, keyboard, trackpad, microphone, audio board, speakers, IPD flex cable, BMU, and keyboard flex cable. Returned top cases must be packaged according to strict guidelines. If the battery, keyboard, microphone or trackpad must be replaced, you must replace the top case. The keyboard flex cable is a separate, replaceable part. Refer to article [TP1538: Battery Handling and Storage](#). Repairs must be done in a designated area for Soft Cell Lithium Battery repairs.
- **Trackpad Calibration Check:** The calibration of the Force Touch trackpad must be verified after every repair. For more information refer to article [TP1314: Trackpad Calibration Check](#).
- **Thermal Ducts:** The fan ducts are rubber gaskets that sit on top of the fans. They are fragile and held down with adhesive. Use care when lifting them to access the fans.
- **Keycaps:** The MacBook Pro (15-inch, 2017) keyboard has new glyphs on the Option and Control keys. Keycap kits for MacBook Pro (15-inch, 2017) can be used on MacBook Pro (15-inch, 2016), but keycap kits for MacBook Pro (15-inch, 2016) cannot be used on MacBook Pro (15-inch, 2017).

Starter Kits

The following kits are needed to service this computer:

- Battery Safety Kit, refer to article [OP685: SERVICE: About embedded battery safety](#)
- Battery Cover, 923-01320, package of two
- Bottom case removal/install fixture kit, 076-00290
- Touch ID alignment kit, 923-01586
- Data Migration Tool Kit, 076-00236

Use Software Update

MacBook Pro (15-inch, 2016 and 2017) ships with a model-specific version of macOS. Refer to article [HT204319: macOS versions and builds included with Mac computers](#) to make sure the system build is correct for this computer model. Using Software Update, check for and apply the latest software and firmware updates.

Serial Number Locations

The system serial number and model number are located on the bottom case. Turn over the computer to view the numbers etched on the bottom case near the hinge.

Note: Bar code readers can be used to read serial numbers inside the computer. For information on the serial number format, refer to article [OP51: Frequently Asked Questions and Answers Concerning Apple's New Serial Number Format](#).

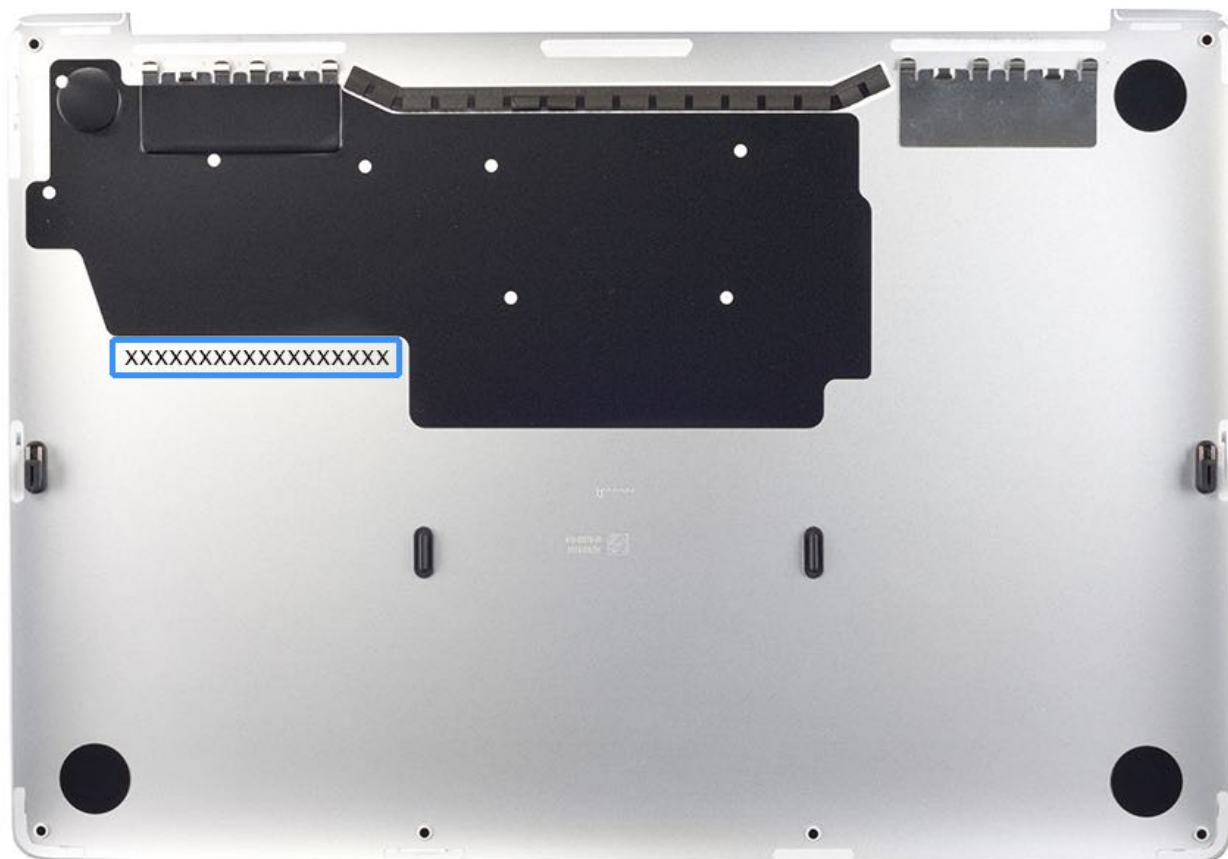
Model and EMC Numbers

- MacBook Pro (13-inch, 2016, Two Thunderbolt 3 Ports): Model Number **A1708**; EMC number **2978**
- MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports): Model Number **A1708**; EMC number **3164**
- MacBook Pro (13-inch, 2016, Four Thunderbolt 3 Ports): Model Number **A1706**; EMC number **3071**
- MacBook Pro (13-inch, 2017, Four Thunderbolt 3 Ports): Model Number **A1706**; EMC number **3163**
- MacBook Pro (15-inch, 2016): Model number **A1707**; EMC number **3072**
- MacBook Pro (15-inch, 2017): Model number **A1707**; EMC number **3162**



Transferring the System Serial Number

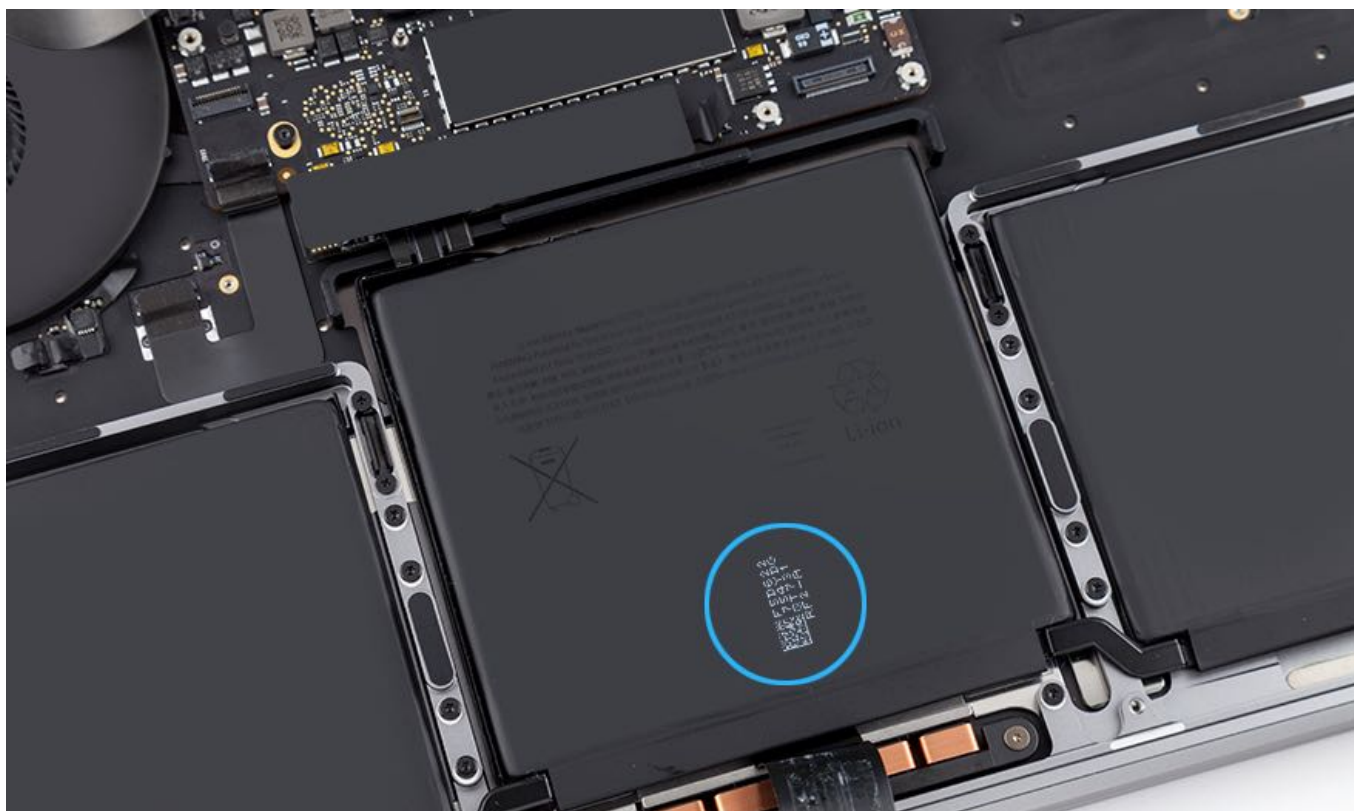
When replacing a bottom case, retain the user's original bottom case until the repair is complete. Before installing **either** a replacement top case or bottom case, use a fine-tipped permanent marker to write the original system serial number inside the bottom case.



Battery Serial Number

Copy the original battery serial number when reporting a top case return to Apple.

The MacBook Pro (13-inch, 2016 and 2017) battery serial number is located underneath the trackpad flex cable. Carefully peel back the trackpad flex cable to view the battery serial number.



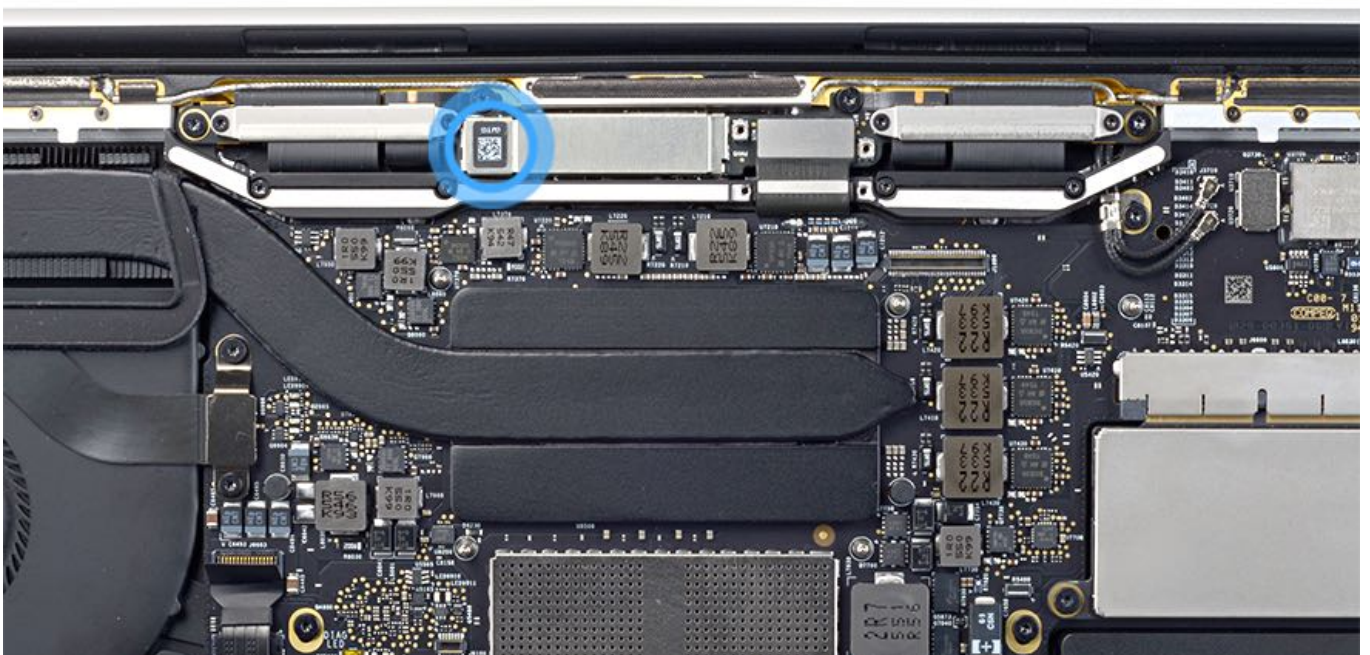
The MacBook Pro (15-inch, 2016 and 2017) battery serial number is located on the BMU board.



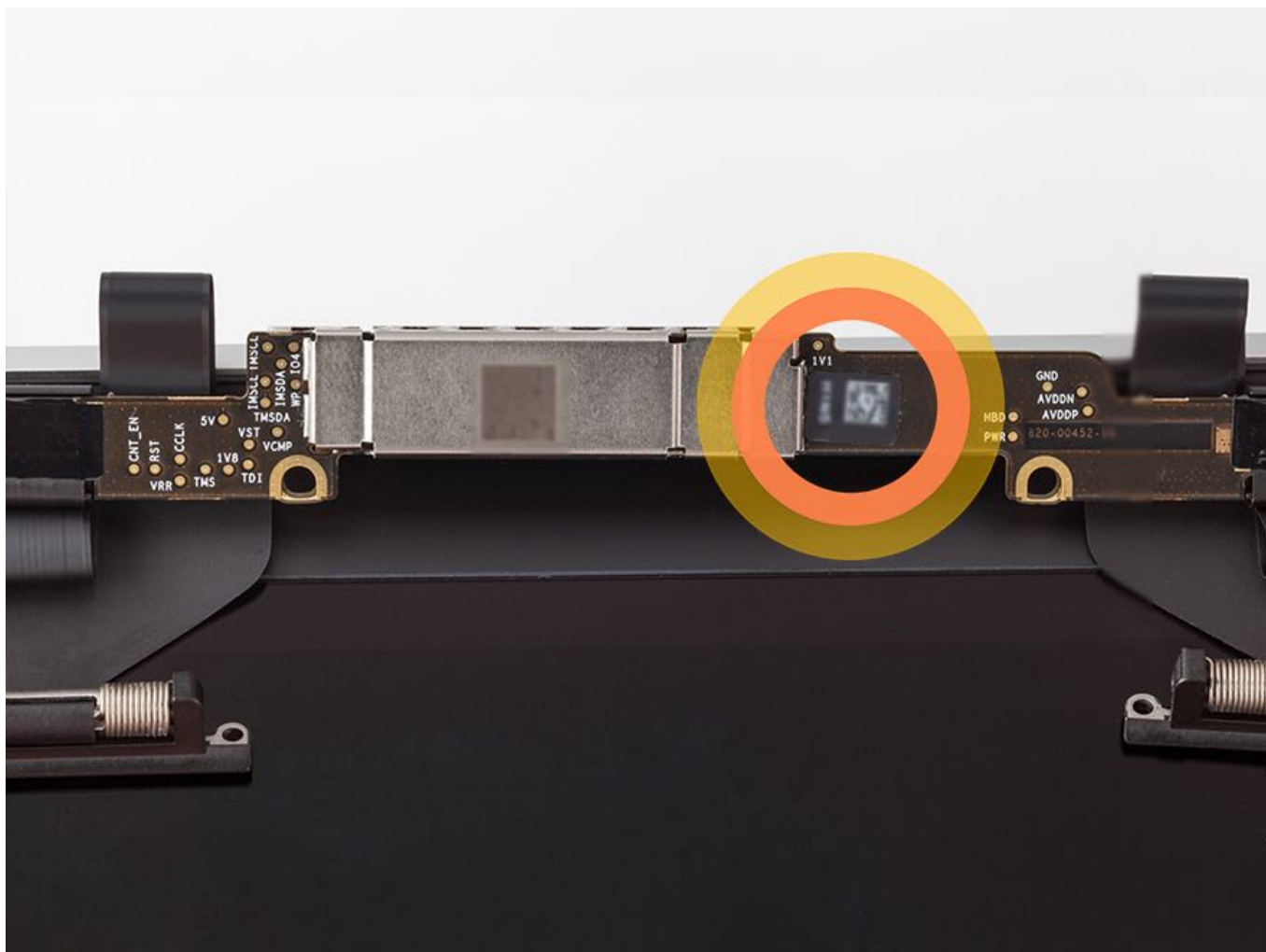
Display Assembly Serial Number

The display serial number is located on the TCON board.

The MacBook Pro (13-inch, 2016 and 2017) display serial number is shown below.



The MacBook Pro (15-inch, 2016 and 2017) display serial number is shown below.



Auto Boot

Auto Boot for MacBook Pro (2016 and 2017) and MacBook (Retina, 12-inch, 2017)

Boot on Lid Open and Boot on AC Attach are two features that automatically turn on the computer. These features must be disabled prior to any repair that involves removing the bottom case. After the repair is complete, these features must be re-enabled.

Boot on Lid Open occurs when:

- the computer is shut down and you open the display to use the computer.
- the battery has enough power (otherwise the computer will show the battery charging icon).

Boot on AC Attach occurs when:

- the computer is shut down while the display is open, and then you plug in the AC power cord.
- the computer is shut down while the display is closed and an external monitor is attached, and then you plug in the AC power cord.

Important: Before you begin any repair, disable both features and unplug the computer for the duration of the repair. After the repair is complete, re-enable these features.

To disable both features before a repair:

1. Double click on the drive that contains the macOS.
2. Open the Applications folder.
3. Open the Utilities folder.
4. Double click on the Terminal application.
5. Type the following text EXACTLY as shown (the last two characters are zeroes):
 - **sudo nvram AutoBoot=%00**

To re-enable both features after a repair:

1. Double click on the drive that contains the macOS.
2. Open the Applications folder.
3. Open the Utilities folder.
4. Double click on the Terminal application.
5. Type the following text EXACTLY as shown (the second to last character is a zero):
 - **sudo nvram AutoBoot=%03**
6. Shut down the computer and close the display.
7. Open the display and verify that the computer turns on.

Data Migration

Data Migration on the MacBook Pro (2016 and 2017)

Use Migration Assistant or target disk mode to transfer data between MacBook Pro (2016 and 2017) with Thunderbolt 3 ports and other Macs.

To transfer data between a MacBook Pro (2016 and 2017) with Thunderbolt 3 ports and another Mac with Thunderbolt, connect a Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter to the MacBook Pro and use a Thunderbolt cable to connect the adapter to the other Mac. Then follow the steps for using Migration Assistant in target disk mode to move your files. For older models with FireWire connection, use the Thunderbolt to FireWire Adapter with a FireWire cable, then follow the steps for using Migration Assistant in target disk mode.

For more information on how to move content to a new Mac using Migration Assistant or target disk mode, refer to article [HT204350: Move your content to a new Mac](#).

Tools:

- Belkin Thunderbolt 3 Cable (923-01131)



- Apple Thunderbolt Cable (661-6029)



- Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter (661-06668)



- Thunderbolt to FireWire Adapter (661-6585)



For further reference, refer to these articles:

- [HT201853: About Apple video adapters and cables](#)
- [HT207266: Connect devices and displays with the Apple Thunderbolt 3 \(USB-C\) to Thunderbolt 2 Adapter](#)
- [HT204360: Using USB-C and Thunderbolt 3 \(USB-C\) ports and adapters on your Mac notebook](#)
- [HT201163: Using USB 3 devices with Mac computers](#)

Battery Safety Setup

Battery Safety Setup for MacBook and MacBook Pro (Mid 2012 and later)



Warning: Before servicing a MacBook or MacBook Pro computer, read and understand article [OP24: Safely handling lithium batteries and lithium battery-powered devices](#).

For information on how to set up your workstation, refer to article [OP685: About embedded battery safety](#).

Battery Handling and Storage

Battery Handling and Storage for MacBook Pro (2016 and 2017)

Best Practices

The battery contains several soft battery cells. Do not press on the battery cells with your fingers, and do not handle the battery pack in any way that might apply any physical pressure to these cells.

- Always attach the battery cover to the battery immediately after removing the bottom case and before beginning any repair. Make sure all four snaps on the battery cover are secure. Refer to the following list for battery cover part numbers:
 - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): **923-01318**
 - MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): **923-01319**
 - MacBook Pro (15-inch, 2016 and 2017): **923-01320**
- Disconnect the battery cable from the logic board whenever the bottom case is removed. Keep the battery cable disconnected during all part removal and reassembly; reconnect it just before replacing the bottom case.
- Do not use a damaged battery cover. If the battery cover is damaged, replace it.
- Remove the battery cover just before replacing the computer's bottom case. Keep the battery cover on the battery at all other times.
- Do not drop a top case assembly with battery. If the top case has been dropped, replace it.

Battery Covers

MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): **923-01318**



MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): **923-01319**



MacBook Pro (15-inch, 2016 and 2017): **923-01320**



Battery Inspection

Refer to article [OP693: Visual battery inspection](#) for the latest visual inspection details.

Packaging a Top Case Assembly with Battery for Return

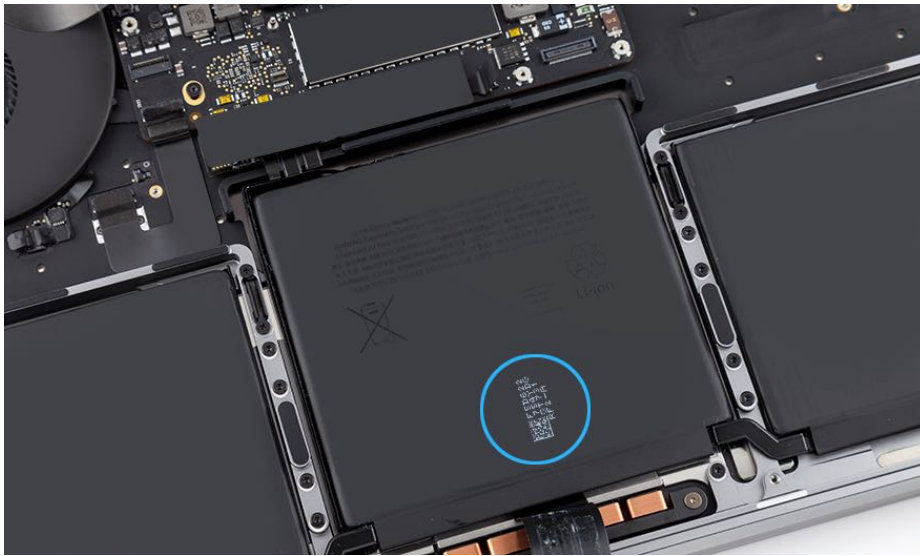
Important: Do not discard the top case packaging.

The same cardboard box and inner packaging used to ship a known-good top case assembly with battery must be used when returning it.



1. Verify that the packaging is in good condition; that labels are present, legible, and intact; and that the box is well-structured and strong.
2. If the box is in good condition but needs a packing list, print a new packing list from article [HT204643: Prepare shipments of lithium batteries and battery-powered equipment](#).
3. If the box is in poor condition, order a replacement box kit (606-0104). The kit includes the outer cardboard box, foam frame, two foam pads, labels, and an ESD or plastic bag.
4. Reuse the protective battery cover from the original top case removal. If a new battery cover is needed, order part from the following list:
 - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): **923-01318**
 - MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): **923-01319**
 - MacBook Pro (15-inch, 2016 and 2017): **923-01320**
5. Make sure the protective battery cover is securely attached to the battery. Install the battery cover as soon as the bottom case is removed and keep it in place for all subsequent part removals.
6. For MacBook Pro (13-inch, 2016 and 2017) models, the serial number is located on the battery. For the MacBook Pro (15-inch, 2016 and 2017) model, the serial number is located on the BMU board. Scan or copy the original battery serial number when reporting the return of the top case assembly with battery to Apple.

MacBook Pro (13-inch, 2016 and 2017)



MacBook Pro (15-inch, 2016 and 2017)



7. Place the top case with covered battery inside the bag.
8. Fold over the bag and seal it closed with the yellow ESD sticker. (If the sticker is not available, use tape.)
9. Place wrapped top case on bottom foam pad within inner foam frame inside cardboard box.
10. **Important:** When placing the wrapped top case into the box, make sure the battery is face up and at the front opening of the box.



10.

11. Carefully place the second foam pad over the wrapped top case.



11.

12. Close the box and seal it with tape. Do not use staples.



12.

13. Make sure the Caution label and packing list are attached to the box.
14. Attach a shipping label and return the top case assembly with battery using normal shipping procedures.



14.

Butterfly Mechanism Keycap Replacement

Butterfly Mechanism Keycap Replacement MacBook Pro (2016 and 2017) and MacBook (Retina, 12-inch, 2017)

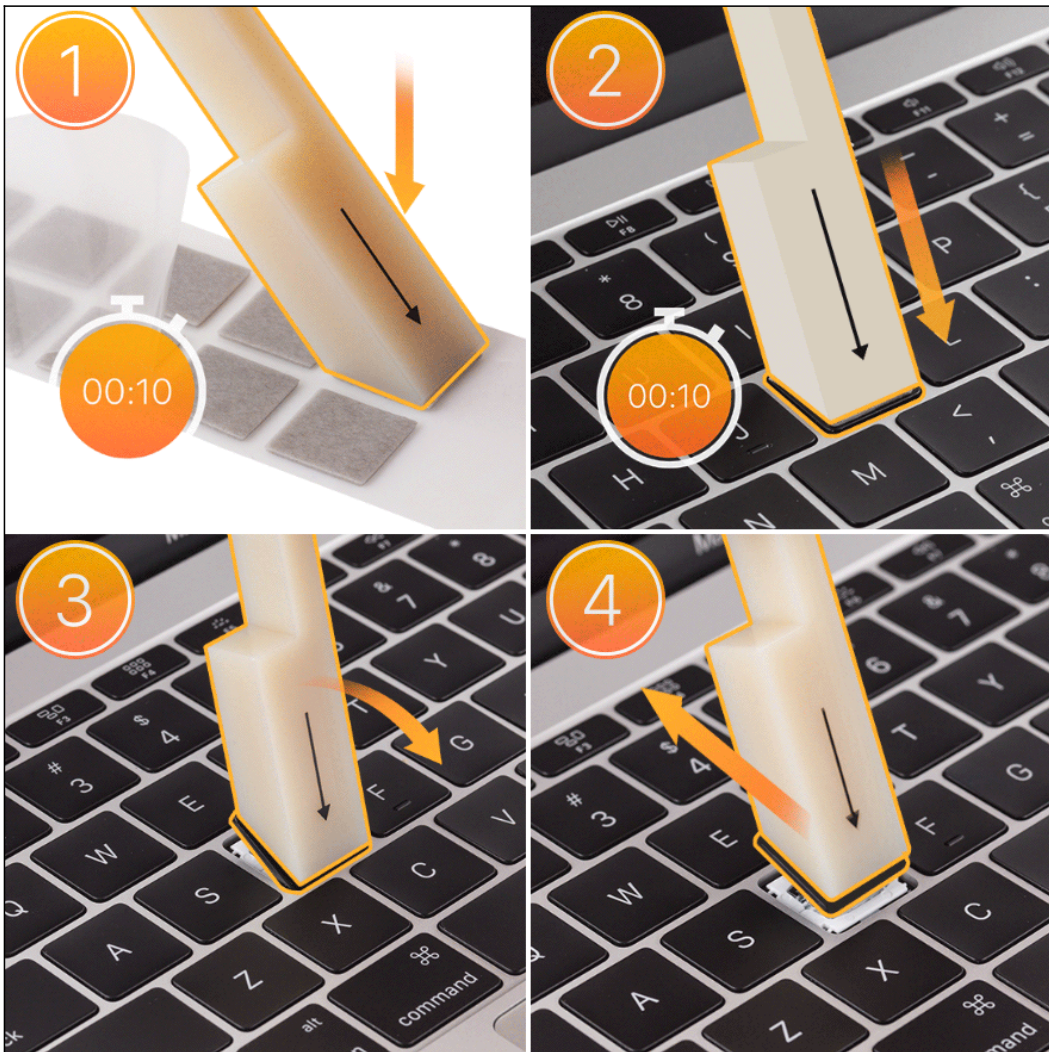
With the introduction of the keycap lever tool, keycaps for MacBook Pro (2016 and 2017) and MacBook (Retina, 12-inch, 2017) computers are now easier and faster to replace. Individual keycaps should be replaced instead of the entire top case. This procedure can be done in under three minutes.

This procedure is the quickest and most cost-effective way to fix the following butterfly mechanism issues:

- Sticking keys (stuck in up or down position)
- Key press feels uneven or stiff
- Keycap not responding, is spongy, or is not going all the way down
- The key makes abnormal noise and/or is a metallic click sound
 - **Note:** For MacBook Pro (2016), first install the keycap shim to the new keycap for this issue. Refer to article [TP1550: Keycap Shim Installation](#).

The procedure involves four basic steps:

1. Applying the adhesive to the tool.
2. Pressing the tool on the keycap for 10 seconds.
3. Pulling the keycap in the correct direction to release snaps.
4. Pushing it in the opposite direction to release hooks.



For video instruction, refer to [SV347: Portables Keycap Lever Video](#).

For part numbers, go to the [Keycap Kit Part Numbers](#) section below.

For a guide to placing the lever tool, see the [Keycap Lever Placement Map](#) below.

For detailed information on the procedure, go to the [Procedure for Removing and Replacing Keycaps](#) section below.

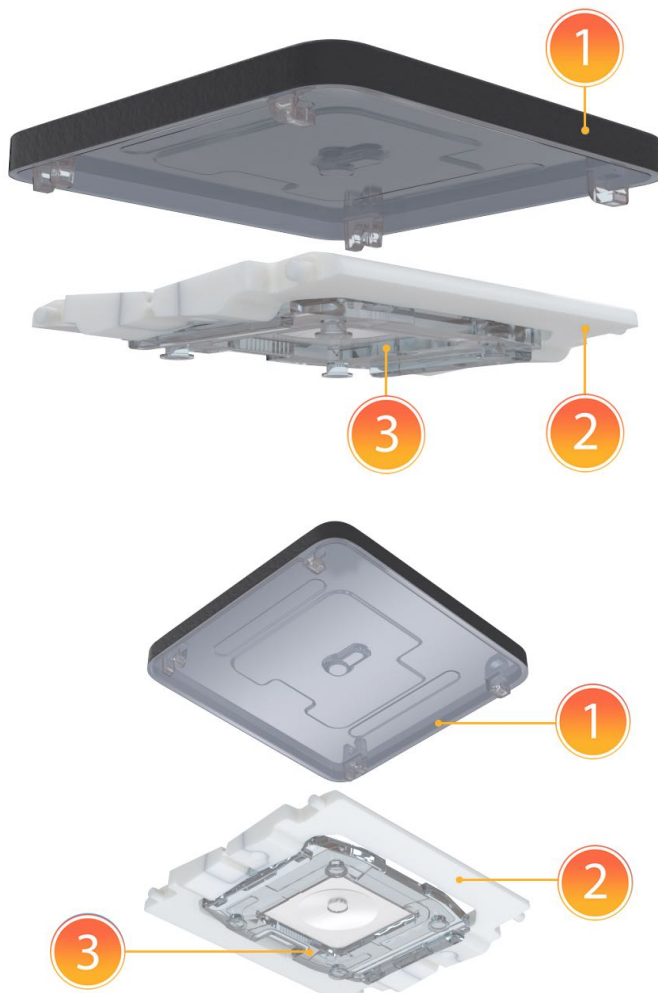
First Steps

- Before replacing the keycap on an unresponsive keyboard, be sure to clean the keyboard thoroughly with compressed air. Then remove the keycap, spray the well with compressed air, and check for liquid damage.
- Before attempting this procedure for the first time, practice on a KBB top case and keyboard with butterfly mechanism.
- Always use a new keycap. Do not attempt to reinstall the keycap that was removed.
- For instructions on removing and replacing the **Space bar**, refer to article [OP1469: Butterfly Mechanism Keycap Replacement](#).
- For instruction on installing a keycap shim to MacBook Pro (2016) keycaps that exhibit a loud clicking sound after the system has warmed up, refer to article [TP1550: Keycap Shim Installation](#).
- For Arabic keyboards, the return key may show uneven backlighting from top to bottom. This is expected behavior. Do not repair or replace for this issue.
- When replacing an option key, make sure the old option key and the new option key have the same glyphs. If they do not, replace both keys.

1. Keycap Anatomy

Keycap mechanisms consist of three parts. Only number 1 is replaceable:

1. Keycap, the surface key that a user sees on the keyboard
2. Butterfly, the hinged piece under the keycap
3. Switch housing, the piece that secures the butterfly to the top case



Important: Although keycaps can be replaced, the butterfly and switch housing cannot. A damaged switch housing or butterfly requires replacement of the entire top case.

If a keycap needs replacement due to accidental damage, such as a liquid spill, refer to article [OP14: Determining and quoting accidental damage for Mac portables](#).

2. Keycap Kit Part Numbers

Important: The keycap kits vary by the computer color and the keyboard language.

To help determine keyboard localization or keycap placement, refer to article [HT201794: How to identify keyboard localizations](#).

Notes:

- Keycap kits are available for UK English (ISO), U.S. English (ANSI), Chinese (ANSI) and Japanese (JIS) version keyboards.
- The **Super ISO** is a European special character kit that includes specific keycap characters for:
 - German (D)
 - French (F)
 - Danish (DK)
 - Italian (T)
 - Spanish (E)
 - Swedish (S)
- **Common Kits** include:
 - ANSI - space bar, left and right shift, caps lock, delete, tab, return, escape
 - JIS - space bar, return, left and right shift, #1, power
 - ISO - space bar, right shift, caps lock, delete, tab, return, escape

MacBook Pro (13-inch, 2016, 2 Thunderbolt 3 Ports)

Part Number	Label Number	Language	Computer Color
923-01088	605-01344	ANSI English	Space Gray
923-01089	605-01345	ANSI English	Silver
923-01661	605-02130	ANSI English Common Kit	Space Gray
923-01660	605-02129	ANSI English Common Kit	Silver
CH923-01088	CH605-01344	ANSI English, China	Space Gray
CH923-01089	CH605-01345	ANSI English, China	Silver
B923-01088	B605-01344	ISO English	Space Gray
B923-01089	B605-01345	ISO English	Silver
ZM923-01088	ZM605-01344	Super ISO English	Space Gray
ZM923-01089	ZM605-01345	Super ISO English	Silver
ZM923-01661	ZM605-02130	ISO English Common Kit	Space Gray
ZM923-01660	ZM605-02129	ISO English Common Kit	Silver
J923-01088	J605-01344	Japanese	Space Gray
J923-01089	J605-01345	Japanese	Silver
J923-01661	J605-02130	Japanese Common Kit	Space Gray
J923-01660	J605-02129	Japanese Common Kit	Silver

MacBook Pro (13-inch, 2016, 4 Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016)

Part Number	Label Number	Language	Computer Color
923-01454	605-01811	ANSI English	Space Gray
923-01455	605-01812	ANSI English	Silver
923-01663	605-02132	ANSI English Common Kit	Space Gray
923-01662	605-02131	ANSI English Common Kit	Silver
CH923-01454	CH605-01811	ANSI English, China	Space Gray
CH923-01455	CH605-01812	ANSI English, China	Silver
B923-01454	B605-01811	ISO English	Space Gray
B923-01455	B605-01812	ISO English	Silver
ZM923-01088	ZM605-01344	Super ISO, English	Space Gray
ZM923-01089	ZM605-01345	Super ISO, English	Silver
ZM923-01663	ZM605-02132	ISO English Common Kit	Space Gray
ZM923-01662	ZM605-02131	ISO English Common Kit	Silver
J923-01454	J605-01811	Japanese	Space Gray
J923-01455	J605-01812	Japanese	Silver
J923-01663	J605-02132	Japanese Common Kit	Space Gray
J923-01662	J605-02131	Japanese Common Kit	Silver

MacBook Pro (13-inch, 2017) and MacBook Pro (15-inch, 2017)

Part Number	Label Number	Language	Computer Color
923-01849	605-03030	ANSI English	Space Gray
923-01850	605-03031	ANSI English	Silver
923-01857	605-03034	ANSI English Common Kit	Space Gray
923-01858	605-03035	ANSI English Common Kit	Silver
CH923-01849	CH605-03030	ANSI English, China	Space Gray
CH923-01850	CH605-03031	ANSI English, China	Silver
B923-01849	B605-03030	ISO English	Space Gray
B923-01850	B605-03031	ISO English	Silver
ZM923-01857	ZM605-03034	ISO English Common Kit	Space Gray
ZM923-01858	ZM605-03035	ISO English Common Kit	Silver
J923-01849	J605-03030	Japanese	Space Gray
J923-01850	J605-03031	Japanese	Silver
J923-01857	J605-03034	Japanese Common Kit	Space Gray
J923-01858	J605-03035	Japanese Common Kit	Silver

MacBook (Retina, 12-inch, 2017)

Part Number	Label Number	Language	Computer Color
923-01730	605-02311	ANSI English	Space Gray
923-01731	605-02312	ANSI English	Silver, Gold, Rose Gold
923-01732	605-02313	ANSI English Common Kit	Space Gray
923-01733	605-02314	ANSI English Common Kit	Silver, Gold, Rose Gold
CH923-01730	CH605-02311	ANSI English, China	Space Gray
CH923-01731	CH605-02312	ANSI English, China	Silver, Gold, Rose Gold
B923-01730	B605-02311	ISO English	Space Gray
B923-01731	B605-02312	ISO English	Silver, Gold, Rose Gold
ZM923-01730	ZM605-02311	Super ISO, English	Space Gray
ZM923-01731	ZM605-02312	Super ISO, English	Silver, Gold, Rose Gold
ZM923-01732	ZM605-02313	ISO English Common Kit	Space Gray
ZM923-01733	ZM605-02314	ISO English Common Kit	Silver, Gold, Rose Gold
J923-01730	J605-02311	Japanese	Space Gray
J923-01731	J605-02312	Japanese	Silver, Gold, Rose Gold
J923-01732	J605-02313	Japanese Common Kit	Space Gray
J923-01733	J605-02314	Japanese Common Kit	Silver, Gold, Rose Gold

3. Keycap Lever Placement Map

The following illustrations show where to place the keycap lever when removing keycaps.

Release the edge of the keycap at the snaps before releasing the edge with the hooks. For detailed instructions, go to the [Procedure](#) section below.



Yellow: The hooks are on the bottom and the snaps are on the top.



Blue: The hooks are on the right and the snaps are on the left.



Orange: There are four snaps on top and four hooks on the bottom.



Purple: The hooks are on the left and the snaps are on the right.



Green: There are three hooks on the bottom and three snaps on the top.

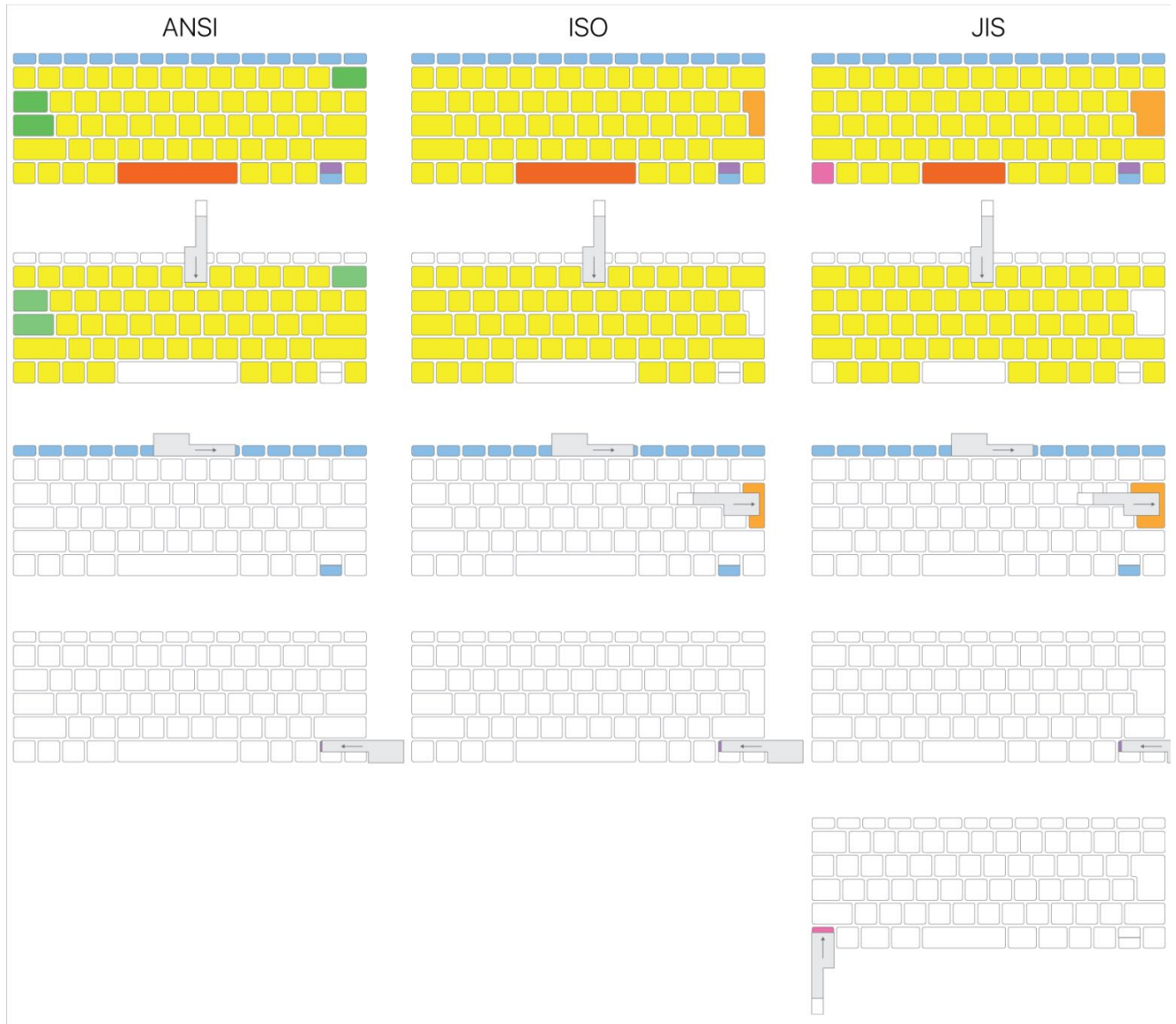


Light Orange: There are three hooks on the right and three snaps on the left.



Pink (Japan only): The hooks are on the top and the snaps are on the bottom.

Click on the image below to enlarge it.

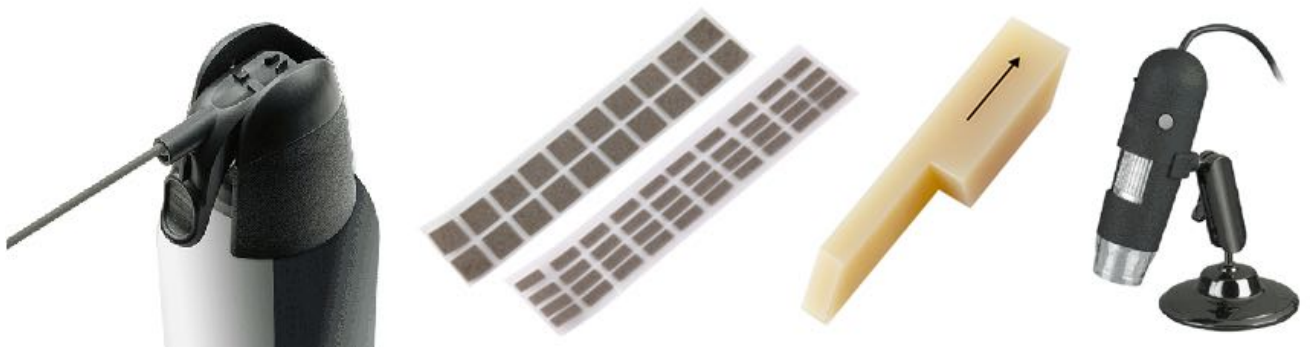


4. Procedure for Removing and Replacing Keycaps

Caution:

- Shut down the computer before replacing a keycap.
- Press the keycap lever very gently on the keycap when initializing the VHB. The top case should not bend when pressing the keycap lever tool onto the keycap. Too much pressure can damage the butterfly resulting in a full top case replacement.
- If the butterfly is damaged, a full top case replacement is required.
- Inspect the switch housing with a USB microscope. If the pockets are damaged, a full top case replacement will be required. Refer to step 9 of Section 4A.

Tools:



- Compressed air
- Pre-cut VHB adhesive strips (923-01801, 1x1; 923-01800, 1x.5)

- Keycap lever (923-01803) **Note:** This tool is double-sided. The large side is for yellow, pink, and green keys; the smaller side is for blue, light orange, and purple keys. This tool is not to be used for the space bar (orange keys).
- USB Microscope
- Keycap tool kit (076-00337) includes: Keycap slider tool, keycap lever, Kapton tape, and pre-cut VHB adhesive strips

Note: Before attempting this procedure for the first time, practice on a KBB top case and keyboard with butterfly mechanism.

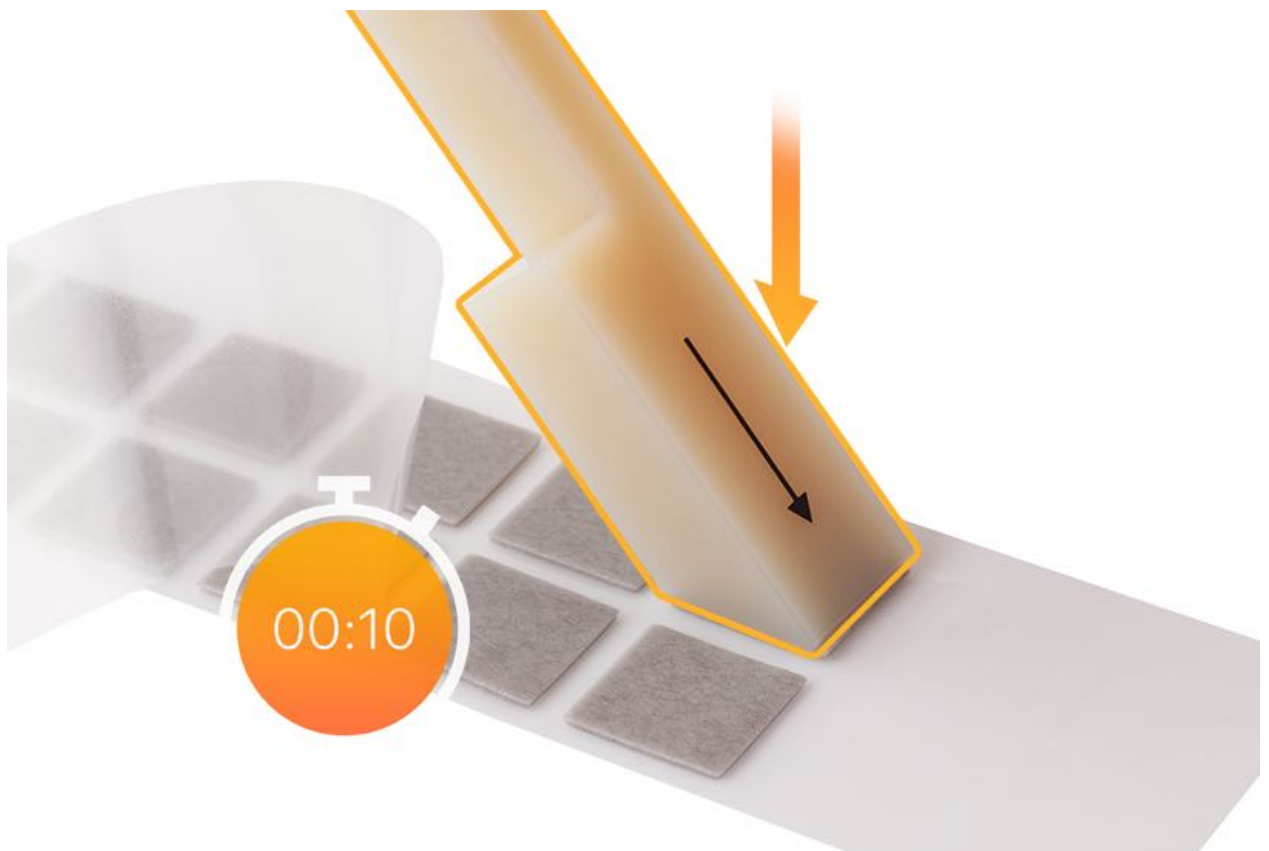
Follow these steps to remove and replace a keycap.

There are four types of keys on the keyboard. Each type requires a different procedure.

- For instructions on removing and replacing the **Space bar**, refer to article [OP1469: Butterfly Mechanism Keycap Replacement](#).

A. Removing and Replacing Yellow, Green, and Pink Keys

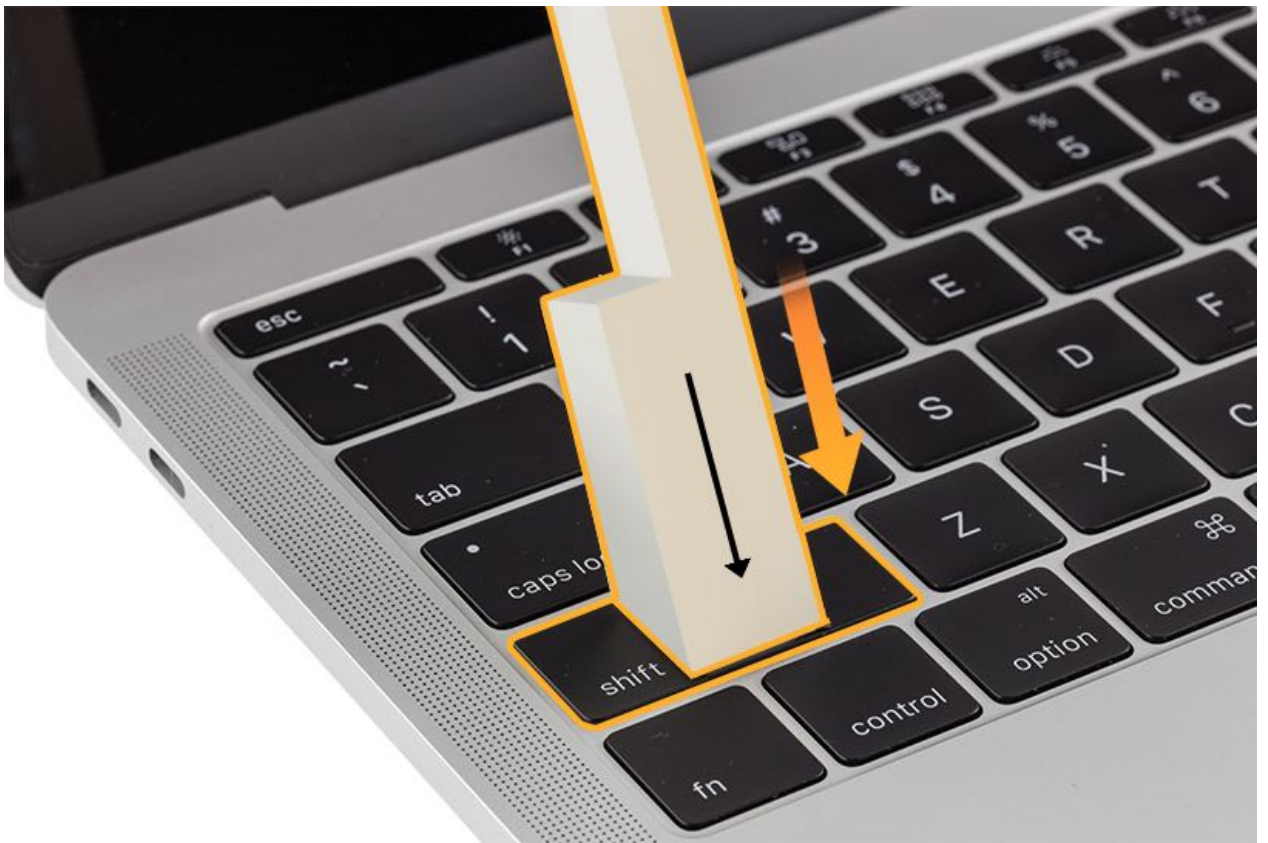
1. Peel back the frosted paper liner from one side of the adhesive. Press the large end of the keycap lever tool onto the 1x1 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.
3. Lightly press the tool with the adhesive side down, onto the key, aligning the arrow on the tool with the hooks on the keycap. See the keycap map for location of hooks.

Note:

- On the larger keys such as caps lock, return, shift, tab, delete, command, place the tool in the middle of the key.
- If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.



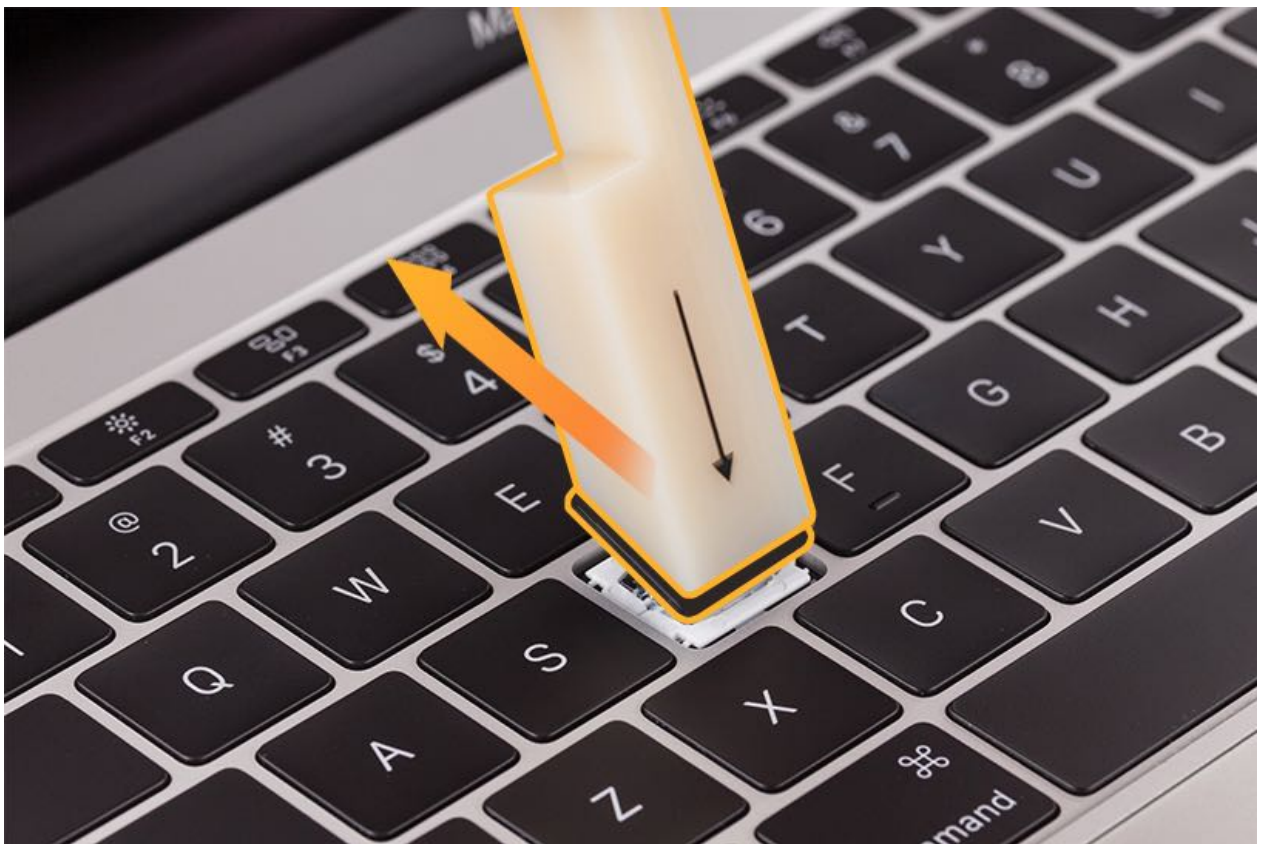
4. Hold for about 10 seconds to activate the adhesive.



5. Slowly pull the lever away from the display to unsnap the keycap. Stop when you hear a click.



6. Then push the lever tool up towards the display to unhook the keycap hooks and remove the keycap.



7. Remove the keycap and the adhesive from the keycap lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

8. Visually inspect the keycap well for debris or foreign objects. If debris is found, use compressed air to clean the keycap well. **Note:** If the debris is visible and compressed air does not dislodge it, use a black stick to gently dislodge the debris.

9. Visually inspect the butterfly. Be sure the pins are properly seated and have not popped out of

place.

10. Using the flat end of a black stick, gently tap the edge of the butterfly on the side of the hinge (circled) and verify that the butterfly moves up and down.



11. If the pins are damaged or not in place or the butterfly does not move up and down, a whole top case replacement is necessary.

12. Always replace the keycap with a new one. Do not reuse keycaps. Insert the bottom of the keycap into the well at a 15-degree angle and gently push to engage the hooks.

13. Gently push down on the top of the keycap to engage the snaps. If the keycap is not lined up properly, the snaps will not engage. If this happens, start again.

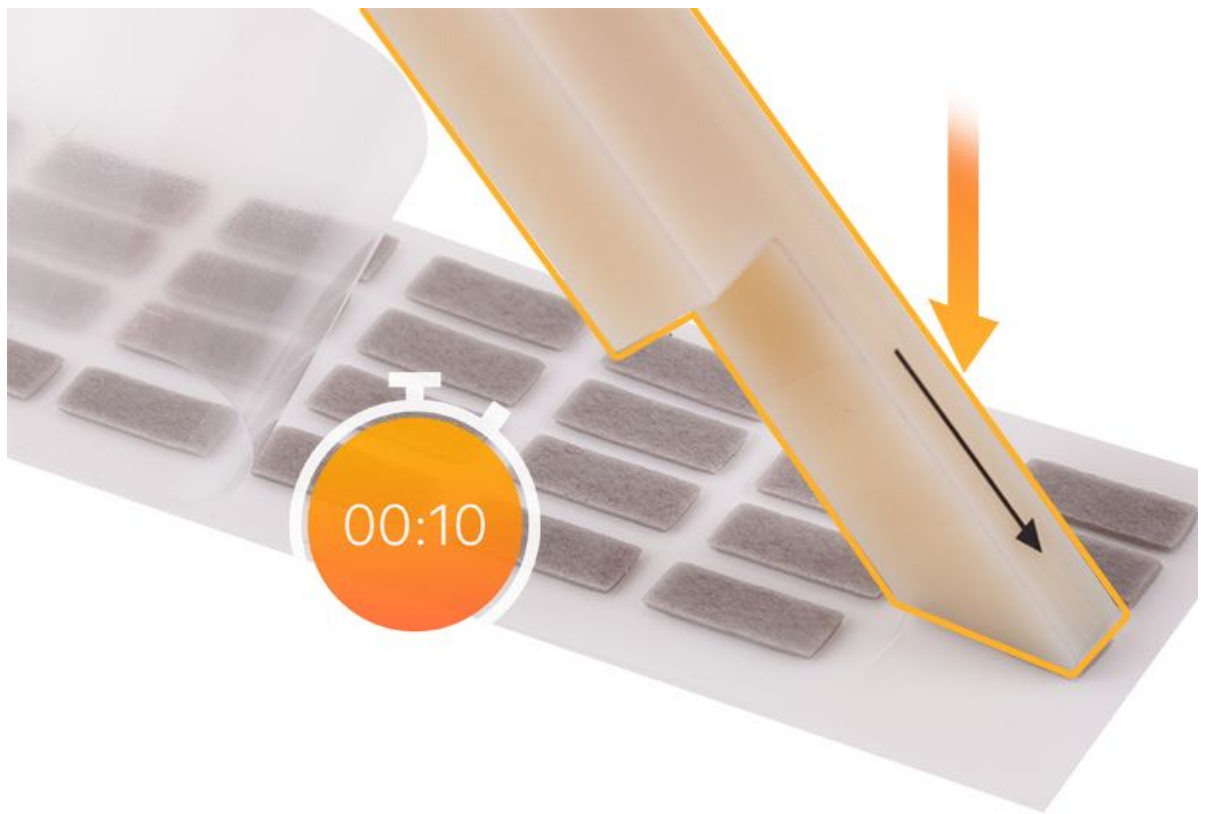
14. Check the key from all angles to make sure it is uniformly flat. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the keycaps around it.

15. When replacing the option key, check to make sure both keys have the same glyphs. If the new option key is different from the old one, replace both keys.

B. Removing and Replacing the Up Arrow Keys (Purple), ISO and JIS Return Keys (Light Orange), and the Function and Down Arrow Keys (Blue)

Steps for Removing the Up Arrow Key

1. Peel back the frosted paper liner from one side of the adhesive. Press the small end of the keycap lever tool onto the 1x.5 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.

3. Lightly press the tool with the adhesive side down, onto the up arrow key, aligning the arrow with the hooks on the left side.

Note: If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.

4. Hold for about 10 seconds to activate the adhesive.



5. Pull the lever to the left to unsnap the keycap. Stop when you hear a click.



6. Then push the lever slightly forward to unhook the hooks and lift up to remove the keycap.

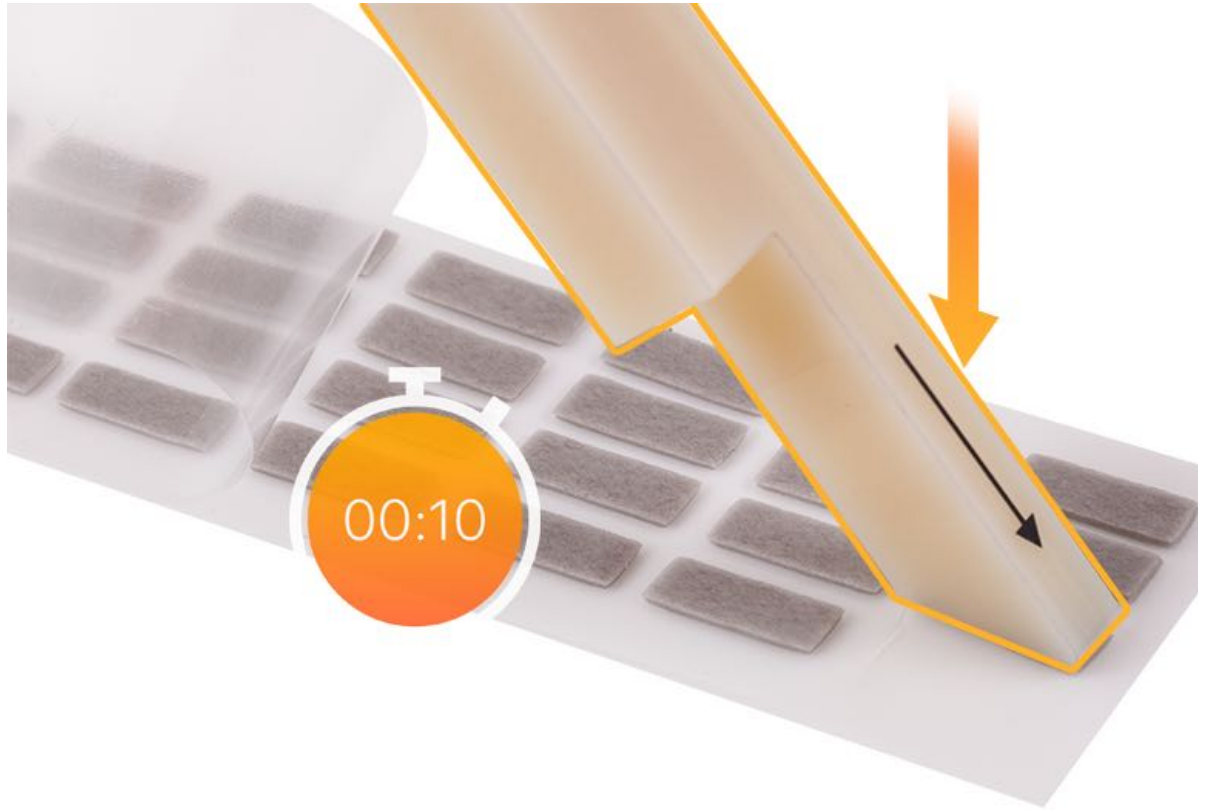


7. Remove the keycap and the adhesive from the lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

Steps for Removing the Down Arrow, JIS and ISO Return, and Function Keys

1. Peel back the frosted paper liner from one side of the adhesive. Press the small end of

the keycap lever tool onto the 1x.5 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.

3. Lightly press the tool with the adhesive side down, onto the down arrow key or function key, aligning the arrow with the hooks on the right side.

Note: If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.

4. Hold for about 10 seconds to activate the adhesive.



5. Slowly pull the lever to the right to unsnap the keycap. Stop when you hear a click.



6. Then push the lever slightly forward to unhook the hooks and lift up to remove the keycap.



7. Remove the keycap and the adhesive from the lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

Replacing the Arrow Keys, JIS and ANSI Return Keys, and Function Keys

1. Visually inspect the butterfly. Be sure the pins are properly seated and have not popped out of place.
2. Using the flat end of a black stick, gently tap the edge of the butterfly on the side of the hinge (circled) and verify that the butterfly moves up and down.



3. If the pins are damaged or not in place or the butterfly does not move up and down, a whole top case replacement is necessary.
4. Always replace the keycap with a new one. Do not reuse keycaps.
 - For the up arrow, insert the right side of the keycap into the well at a 15-degree angle and gently push to engage the hooks.
 - For the down arrow and function keys, insert the left side of the keycap into the well at a 15-degree angle and gently push to engage the hooks.
5. Gently push down on the left side of the keycap to engage the snaps. If the keycap is not lined up properly, the snaps will not engage. If this happens, start again.
6. Check the key from all angles to make sure it is uniformly flat. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the keycaps around it.

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Visual/Mechanical Inspection (VMI) Guide for Mac Computers - Table of Contents

- [Mac Displays](#)
- [Liquid Damage](#)
- [Power Adapters](#)
- [USB-C Cables](#)

Liquid Contact Indicators

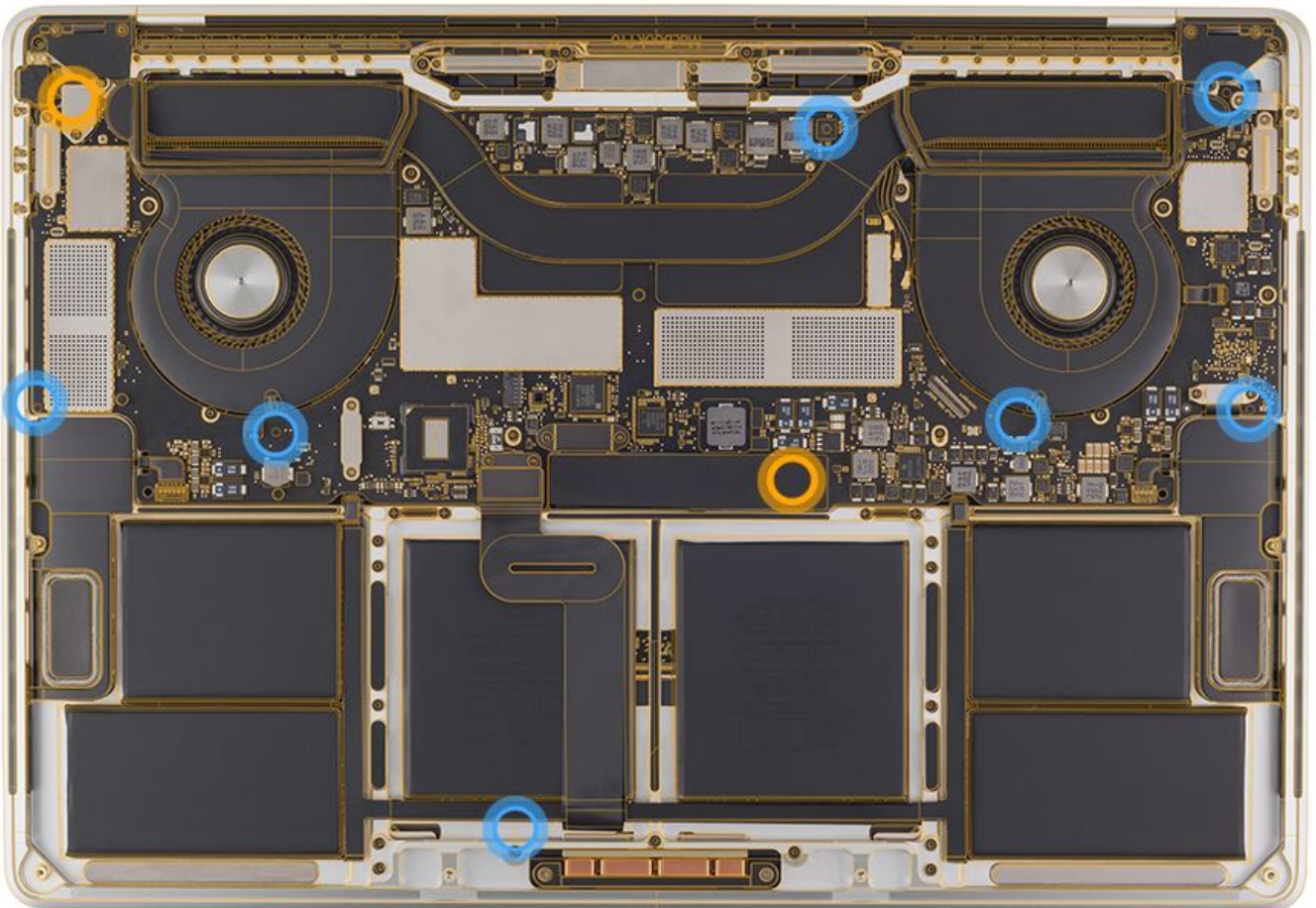
Liquid Contact Indicators for MacBook Pro (Retina, 15-inch, 2016 and 2017)

Liquid Contact Indicators (LCIs) help determine if a computer has been exposed to liquid. Normally represented by small white dots, the LCIs turn red when they have come in contact with liquid, such as an accidental spill.

Important: The LCI is a tool that helps technicians identify whether or not a product has been in contact with liquid. Technicians should not rely solely on this tool, but should perform a thorough examination for signs of liquid contact, such as corrosion.

For more information, refer to article [HT204769: Mac computers: About liquid contact indicators \(LCIs\) and warranty coverage](#).

- Blue circles = visible
- Orange circles = under a component



General Troubleshooting

Update Software and Firmware

Important: Before you begin troubleshooting, ensure the correct version of macOS is installed, and check for and apply the latest software and firmware updates. Computers sometimes exhibit symptoms that indicate the wrong version of macOS system software is installed. Check article [HT204319: macOS versions and builds included with Mac computers](#) to make sure system build is correct for this computer model.

Firmware is the name given to software that is written into memory circuits such as flash memory, that will hold the software code indefinitely, even when power is removed from the hardware. Firmware on Intel Mac computers is designed to be updated if necessary by running the macOS Software Update check (available in the Apple () menu) while the computer is connected to the Internet.

For more information about firmware updates, refer to article [HT201518: About EFI and SMC firmware updates for Intel-based Mac computers](#).

Troubleshooting Techniques

For more information, go to [ATLAS](#) and enter “troubleshooting” in the search field.

Hardware vs. Software

To isolate a hardware issue from a software issue, refer to article [HT203161: Isolating issues in macOS](#).

To troubleshoot a software issue, refer to the following articles:

- [HT201516: How to troubleshoot a software issue](#)
- [HT201861: About incompatible software on your Mac](#)
- [HT204323: If a flashing question mark appears when you start your Mac](#)
- [HT204904: How to reinstall macOS](#)
- [HT202574: Mac mini \(Late 2012 and later\), iMac \(Late 2012 and later\): About Fusion Drive](#)

Quick Check Procedures

Resetting the System Management Controller (SMC)

The System Management Controller (SMC) is a chip on the logic board that controls all power functions. If the computer is experiencing any power issue, such as not starting up, not displaying video, sleep issues, or fan noise issues, resetting SMC may resolve it.

For more information and instructions to reset the SMC on different computer models, refer to article [HT201295: Reset the System Management Controller \(SMC\) on your Mac](#).

Note for iMacs: If the power button is pressed while inserting the power cord, the iMac will enter a mode in which the fans run at full speed. For more information, refer to article [HT204463: iMac: Fans run at full speed after computer turns on](#).

Resetting Non-Volatile RAM (NVRAM)

NVRAM stores certain system and device settings in a location that macOS can access quickly. Exactly which settings are stored in the computer's NVRAM varies depending on the type of computer as well as the types of devices and drives connected. To reset NVRAM:

1. Shut down the computer.
2. Locate the following keys on the keyboard: Command, Option (Alt), P, and R. You will need to hold these keys down simultaneously in Step 4.
3. Press power button.
4. Immediately press and hold Command-Option-P-R keys.
Important: You must press this key combination before the gray screen appears.
5. Hold down keys until computer restarts, and you hear startup chime a second time.
Note: For MacBook Pro (Late 2016 and 2017) and MacBook (Retina, 12-inch, 2017), hold down keys for at least 20 seconds. There is no startup chime.
6. Release keys.

Note: After resetting NVRAM, you might need to reconfigure settings for speaker volume, screen resolution, startup disk selection, and time zone information.

For more information, refer to article [HT204063: How to Reset NVRAM on your Mac](#).

Starting Up in Safe Mode

Safe Mode (sometimes called Safe Boot) is a way to start up a Mac so that it performs certain checks and prevents some software from automatically loading or opening. These changes can help resolve or isolate certain issues on the startup disk.

Follow these steps to start up into Safe Mode:

1. Be sure the computer is shut down.
2. Press the power button.
3. Press and hold the Shift key.
Note: The Shift key should be pressed as soon as possible after the power button is pressed.
4. Release the Shift key when you see the Apple logo appear on the screen. After the Apple logo appears, it may take longer than usual to reach the login screen. This is because the computer is performing a directory check as part of Safe Mode.
5. To leave Safe Mode, restart the computer without pressing any keys during startup.

For more information, refer to article [HT201262: Use Safe Mode to isolate issues with your Mac](#).

Recovering a Lost Firmware Password

Only Apple Retail Stores or Apple Authorized Service Providers can unlock the following Mac models when protected by a firmware password:

- iMac (Mid 2011 and later)
- MacBook (Retina, 12-inch, Early 2015 and later)
- MacBook Air (Late 2010 and later)
- MacBook Pro (Early 2011 and later)
- Mac mini (Mid 2011 and later)
- Mac Pro (Late 2013)

Refer to the technician instructions in article [HT203409: If you lost or forgot your firmware password](#).

Sleep Status Tips

Sleep Status Tips for MacBook (Retina, 12-inch, Early 2015 and later) and MacBook Pro (2016 and later)

These computer models do not have a sleep LED. To troubleshoot without one:

- Press and hold the Caps Lock key to wake the computer from sleep. The Caps Lock LED is a good indication of power.
- Check the haptic response of the trackpad. The trackpad will not have any haptic response when there is no power to the system.
- Open the display and press an alphanumeric key to wake the computer from sleep.
- A computer that has been asleep for an extended period can consume the remaining charge of the battery. Restore power to the computer with a known-good power adapter.
The computer will start up from a hibernation file and start up from where it left off.
- Use an Apple USB-C to USB Adapter, Apple USB-C Digital AV Multiport Adapter, or an Apple USB-C VGA Multiport Adapter to connect a USB device that has a power-on or activity LED. As power is restored to the USB and the system wakes from sleep, the LED lights up.
Note: An Apple USB-C to USB adapter may be used if power does not need to be supplied to the computer.
- Resetting the SMC instantly shuts down the computer, with some side effects:
 - If the computer is in sleep mode, it will reboot from a hibernation file.
 - If the computer is running OS X or macOS during the SMC reset, data from open applications can be lost.
 - If the computer is already shut down, there will be no side effects.

Diagnostic Software

Apple Service Toolkit 2 (AST 2)

AST 2 is a cloud-based diagnostic system to help technicians triage and verify repairs for iOS devices and Mac computers released in June 2014 and later, except for MacBook Pro (Retina, Mid 2014). With AST 2, technicians initiate diagnostics wirelessly on a user's device using a Diagnostic Console (a web application on a Mac or iPad). Technicians are also able to view diagnostic results on the Diagnostic Console.

For more information, refer to:

- [OP476: Latest Apple Service Toolkit download links and documentation](#)
- [TP1105: AST 2 for Mac Reference Guide - Table of Contents](#)
- [TP1118: AST 2 for Mac Reference Guide - Table of Contents \(Retail\)](#)

Apple Diagnostics

Apple Diagnostics is a customer-facing software tool that is built-in to all Mac computers released in June 2013 and later.

For more information, refer to:

- [HT202731: How to use Apple Diagnostics on your Mac](#)
- [HT203747: Apple Diagnostics: Reference codes](#)

Thermal and Electrical Sensors

Thermal and Electrical Sensors for MacBook Pro (15-inch, 2016 and 2017)

Thermal Sensor Table

SMC Name	Location	General Description (Degrees C)	Repair Suggestion
TaLC	Logic board top side, left, near left USB-C ports	Airflow left temperature	Excessive I/O temperature or logic board sensor is damaged or disconnected from SMC. Check USB-C I/O connections and fan operation.
TaRC	Logic board top side, right, near right USB-C ports	Airflow right temperature	Excessive I/O temperature or logic board sensor is damaged or disconnected from SMC. Check USB-C I/O connections and fan operation.
TB0T	Battery	Battery TS_MAX temperature	Excessive battery temperature, open/damaged BMU or logic board contacts.
TB1T	On BMU	Battery TS1 temperature	Excessive battery temperature, open/damaged BMU or logic board contacts.
TB2T	Near battery cell	Battery TS2 temperature	Excessive battery temperature, open/damaged BMU or logic board contacts.
TC0P	Logic board bottom side, under CPU	CPU proximity temperature	Excessive CPU temperature or logic board sensor near CPU is damaged or disconnected from SMC.
TC1C	Logic board bottom side, CPU	CPU die - Digital Core 0 temperature	Excessive CPU temperature or logic board sensor near CPU is damaged or disconnected from SMC.
TC2C	Logic board bottom side, CPU	CPU die - Digital Core 1 temperature	Excessive CPU temperature or logic board sensor near CPU is damaged or disconnected from SMC.
TC3C	Logic board bottom side, CPU	CPU die - Digital Core 2 temperature	Excessive CPU temperature or logic board sensor near CPU is damaged or disconnected from SMC.
TC4C	Logic board bottom side, CPU	CPU die - Digital Core 3 temperature	Excessive CPU temperature or logic board sensor near CPU is damaged or disconnected from SMC.
TCGC	Logic board bottom side, CPU	CPU Gfx Core Temp	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCMX	Logic board bottom side, CPU	Max PECI reported temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCSA	Logic board bottom side, CPU	CPU System Agent Core temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCXC	Logic board bottom side, CPU	CPU Core PECI temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TH0A	Logic board top side, right, near flash storage	S3x Proximity temperature	Excessive flash storage temperature or logic board sensor near flash storage is damaged or disconnected from SMC.
TH0B	Logic board top side, right, near flash storage	NAND#1 Proximity temperature	Excessive flash storage temperature or logic board sensor near flash storage is damaged or disconnected from SMC.
TH0C	Logic board top side, right, near flash storage	NAND#2 Proximity temperature	Excessive flash storage temperature or logic board sensor near flash storage is damaged or disconnected from SMC.
Th1H	Logic board top side, center rear edge, near right fan cutout	Fin Stack proximity right temperature	Excessive heat sink fin stack temperature or fin stack proximity sensor on logic board is damaged. Verify fan is operational for proper cooling.
Th2H	Logic board top side, center rear edge, near left fan cutout	Fin Stack proximity left temperature	Excessive heat sink fin stack temperature or fin stack proximity sensor on logic board is damaged. Verify fan is operational for proper cooling.
TM0P	Logic board bottom side, under shield, between memory IC's	Memory proximity temperature	Excessive memory area temperature or logic board sensor near memory is damaged or disconnected from SMC.
TPCD	Logic board bottom side, center, near large PCH IC	PCH Die - Digital temperature	Excessive PCH temperature or internal CPU sensor is damaged or disconnected from SMC.
Ts0P	Trackpad	Palm rest temperature	Excessive trackpad / palm rest area temperature or sensor is damaged or disconnected from SMC.
Ts1P	Actuator (trackpad)	Trackpad actuator temperature	Excessive trackpad actuator temperature or sensor is damaged or disconnected from SMC.

Electrical Sensor Table

SMC Name	Location	General Description	Units	Repair Suggestion
I18C	Logic board	Current: 1.8V	Amperes	Out of range current from the CPU's integrated voltage regulators.
IAPC	Logic board	Current: WLAN	Amperes	Out of range Wi-Fi current found or open signal to SMC.
IB0L	Logic board	Current: Battery Discrete	Amperes	Out-of-range battery current was found or open signal to SMC. Verify the battery connection to the logic board.
IBLR	Logic board	Current: LCD Backlight	Amperes	Out of range LCD backlight current found or open signal to SMC.
IBTC	Logic board	Current: BT	Amperes	Out of range Bluetooth current found or open signal to SMC.
IC0R	Logic board	Current: CPU High (CPU GT/GTX/VCCIO/MEM)	Amperes	Out of range CPU current was found or open signal to SMC.
ICAC	Logic board	Current: CPU IA Core Discrete	Amperes	Out of range CPU current was found or open signal to SMC.
ICAM	Logic board	Current: CPU IA Core (IMON)	Amperes	Out of range CPU current was found or open signal to SMC.
ICEC	Logic board	Current: CPU VCCEDRAM	Amperes	Out of range CPU current was found or open signal to SMC.
ICGC	Logic board	Current: CPU GT+GTX Discrete	Amperes	Out of range CPU current was found or open signal to SMC.
ICGM	Logic board	Current: CPU GT+GTX (IMON)	Amperes	Out of range CPU current was found or open signal to SMC.
ICMC	Logic board	Current: Camera	Amperes	Out of range camera current was found or open signal to SMC.
ICSC	Logic board	Current: CPU VCCSA	Amperes	Out of range CPU current was found or open signal to SMC.
ICTC	Logic board	Current: CPU GT	Amperes	Out of range CPU current was found or open signal to SMC.
ICTM	Logic board	Current: CPU GT (IMON)	Amperes	Out of range CPU current was found or open signal to SMC.
ID0R	Logic board	Current: USB-C/MPM input (AMON)	Amperes	Out of range DC-IN current. Possible defective power adapter, defective USB-C connector or open signal to SMC. Verify the correct power adapter, charge cable, and I/O connections.
IF3C	Logic board	Current: T139 3.3V	Amperes	Out of range current from the CPU's integrated voltage regulators.
IF5C	Logic board	Current: T139 5V	Amperes	Out of range current from the CPU's integrated voltage regulators.
IHDC	Logic board	Current: SSD Picollo 3.3V	Amperes	Out of range flash storage current found or open signal to SMC.
IHNC	Logic board	Current: SSD NAND	Amperes	Out of range flash storage current found or open signal to SMC.
IIDC	Logic board	Current: T151 (MESA)	Amperes	Out of range Touch ID current found or open signal to SMC.
IKBC	Logic board	Current: Keyboard backlight	Amperes	Out of range keyboard backlight current found or open signal to SMC.
ILDC	Logic board	Current: LCD Panel	Amperes	Out of range LCD panel current found or open signal to SMC.
IM0C	Logic board	Current: 1.2V (CPU & Memory)	Amperes	Out of range current from the CPU's integrated voltage regulators.
IM1C	Logic board	Current: LPDDR 1.8V	Amperes	Out of range current from the CPU's integrated voltage regulators.
IMCC	Logic board	Current: CPU LPDDR 1.2V	Amperes	Out of range current from the CPU's integrated voltage regulators.
IO3R	Logic board	Current: Other 3.3V (High)	Amperes	Out of range current from the CPU's integrated voltage regulators.
IO5R	Logic board	Current: Other 5V (High)	Amperes	Out of range current from the CPU's integrated voltage regulators.

IPBR	Logic board	Current: Battery (BMON)	Amperes	Out-of-range battery current was found or open signal to SMC. Verify the battery connection to the logic board.
IT3C	Logic board	Current: Trackpad & Keyboard 3.3V	Amperes	Out of range keyboard or trackpad current found or open signal to SMC.
ITAR	Logic board	Current: Trackpad Actuator (High)	Amperes	Out of range trackpad actuator current found or open signal to SMC.
IULC	Logic board	Current: TBT Left	Amperes	Out of range Thunderbolt current found or open signal to SMC.
IURC	Logic board	Current: TBT Right	Amperes	Out of range Thunderbolt current found or open signal to SMC.
VCAC	Logic board	Voltage: CPU IA Core	Volts	Out of range voltage from the CPU's integrated voltage regulators.
VCSC	Logic board	Voltage: CPU VCCSA	Volts	Out of range voltage from the CPU's integrated voltage regulators.
VCTC	Logic board	Voltage: CPU GT	Volts	Out of range voltage from the CPU's integrated voltage regulators.
VD0R	Logic board	Voltage: USB-C/MPM input (AMON)	Volts	Out of range DC-IN voltage. Possible defective power adapter, defective USB-C connector or open signal to SMC. Verify the correct power adapter, charge cable, and I/O connections.
VP0R	Logic board	Voltage: P-Bus	Volts	Out of range voltage from battery or charge circuitry found on the logic board, or open signal to SMC. Use correct power adapter and verify that the connector pins are clean and make a good electrical connection. Recharge the battery.

Temperature Concerns

The normal operating temperature of this computer is well within national and international safety standards. Nevertheless, users may be concerned about generated heat. To prevent an unnecessary repair, compare a user's computer to a similar running model under similar load, if available at the repair site.

For more information, refer to articles

- [HT201640: Mac notebooks: Operating temperature](#)
- [HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity](#)
- [HT202179: About fans and fan noise in your Mac](#)

LCD Pixel Anomalies

When displaying a single color over the screen area, the LCD panel might show one or more pixels that are not properly lit.

LCD technology uses rows and columns of addressable points (pixels) that render text and images on the screen. Each pixel has three separate subpixels—red, green, and blue—that allow an image to render in full color. Each subpixel has a corresponding transistor responsible for turning that subpixel on and off.

Depending on the display size, there can be thousands or millions of subpixels on the LCD panel. For example, the LCD panel used in the iMac (27-inch, Late 2013) has a display resolution of 2560 by 1440, which means that there are 3.7 million pixels. Each pixel is made up of a red, a green, and a blue subpixel, resulting in over 11 million individual picture elements on the 27-inch display. Occasionally, a transistor may not work perfectly, which results in the affected subpixel remaining off (dark) or on (bright). With the millions of subpixels on a display, it is possible to have a low number of such transistors on an LCD. In some cases, a small piece of dust or other foreign material may appear to be a pixel anomaly. Apple strives to use the highest quality LCD panels in its products; however, pixel anomalies can occur in a small percentage of panels.

In some cases, pixel anomalies are caused by a piece of foreign material that is trapped somewhere inside the display or on the front surface of the display or glass panel. Foreign material is typically irregular in shape and is usually most noticeable when viewed against a white background.

- For any computer, foreign material on the outer surface of the display or glass panel can be easily removed using a lint-free cloth.
- For iMacs only, foreign material trapped between the glass panel and display should be removed by an Apple Authorized Service Provider or Apple Retail Store.
- For any computer, foreign material trapped inside the display can only be resolved by replacing the entire display assembly.


To determine if the display has an acceptable number of pixel anomalies, see the appropriate article:

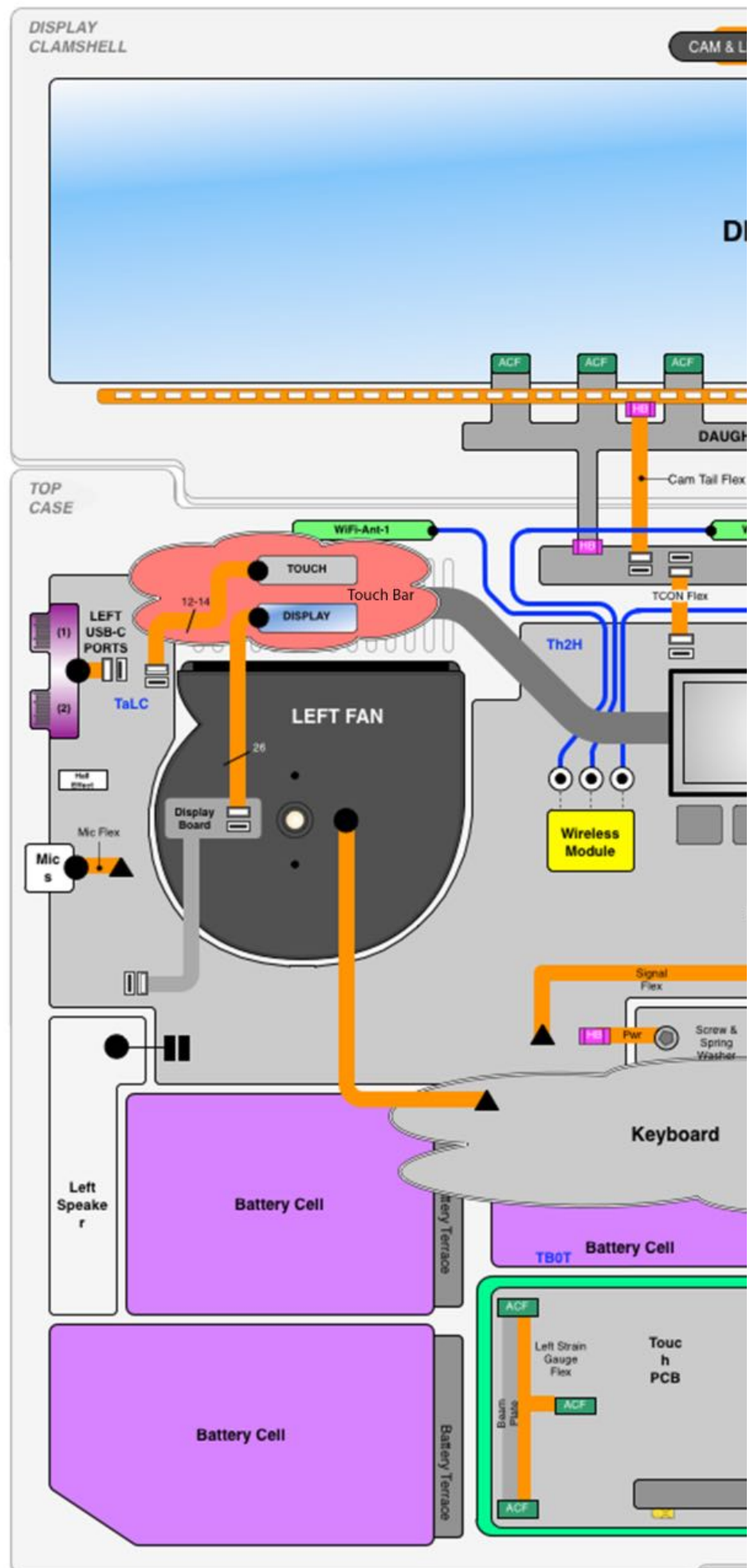
- [HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later](#)
- [HT201613: About LCD display pixel anomalies for Apple products released before 2010](#)

Interconnect Diagram

Interconnect Diagram for MacBook Pro (15-inch, 2016 and 2017)

Refer to this diagram to see how modules are interconnected. Click on the image to enlarge.

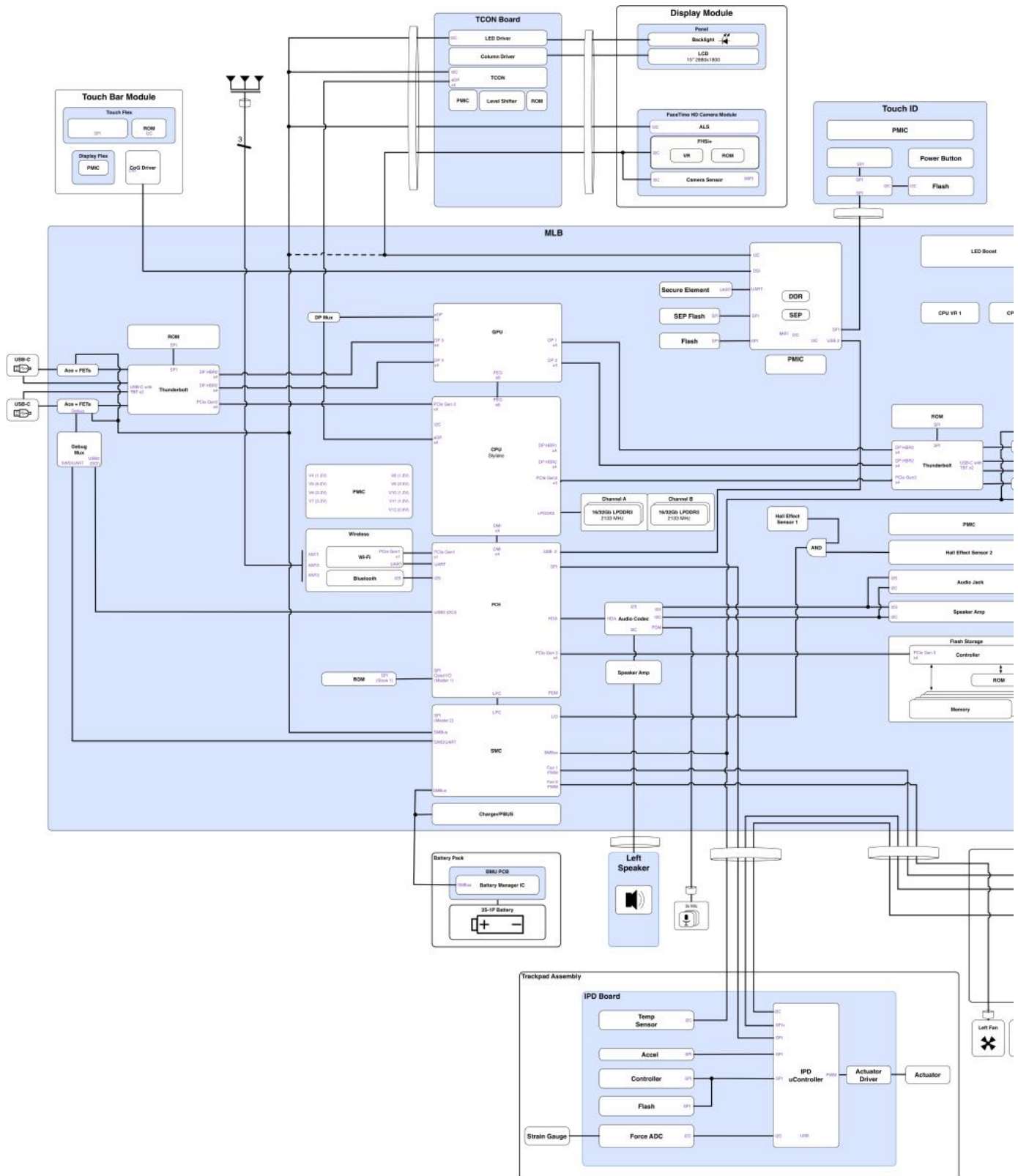
LEGEND	
	Flex
	Coax
	Wire
	ZIF
	LIF
	WTB
	BTB (Rcpt)
	BTB (Plug)
	BTB (Other)
	Rigid Flex
	Hot Bar
	Anisotropic Conductive Film
	Direct Solder
	WTB Circular
	Custom Conn
	# of Lanes/Wires
Th2H	Temperature sensor



Block Diagram

Block Diagram for MacBook Pro (15-inch, 2016)

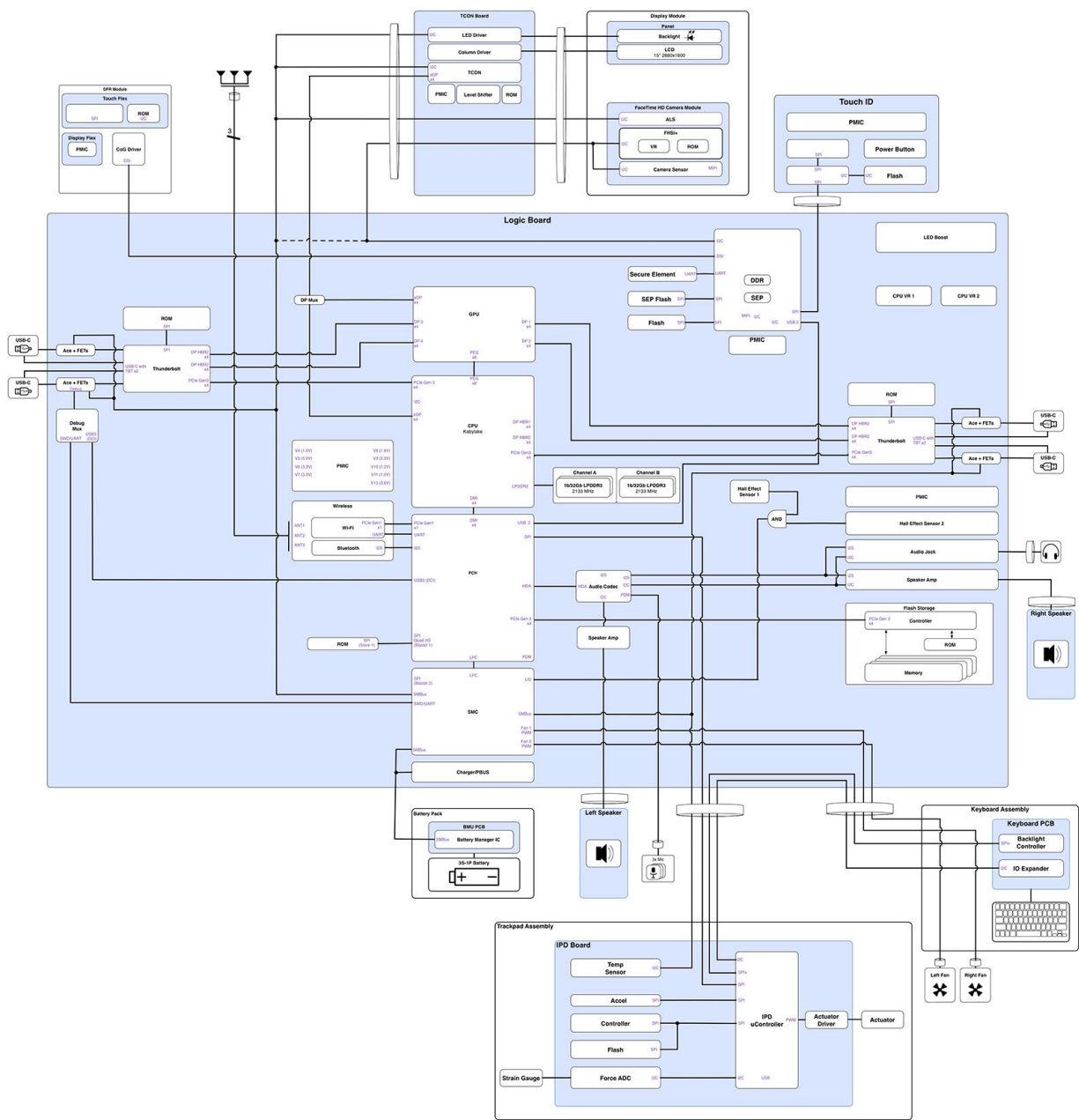
Refer to this diagram to see how modules are interrelated. Click on the image to enlarge.



Block Diagram

Block Diagram for MacBook Pro (15-inch, 2017)

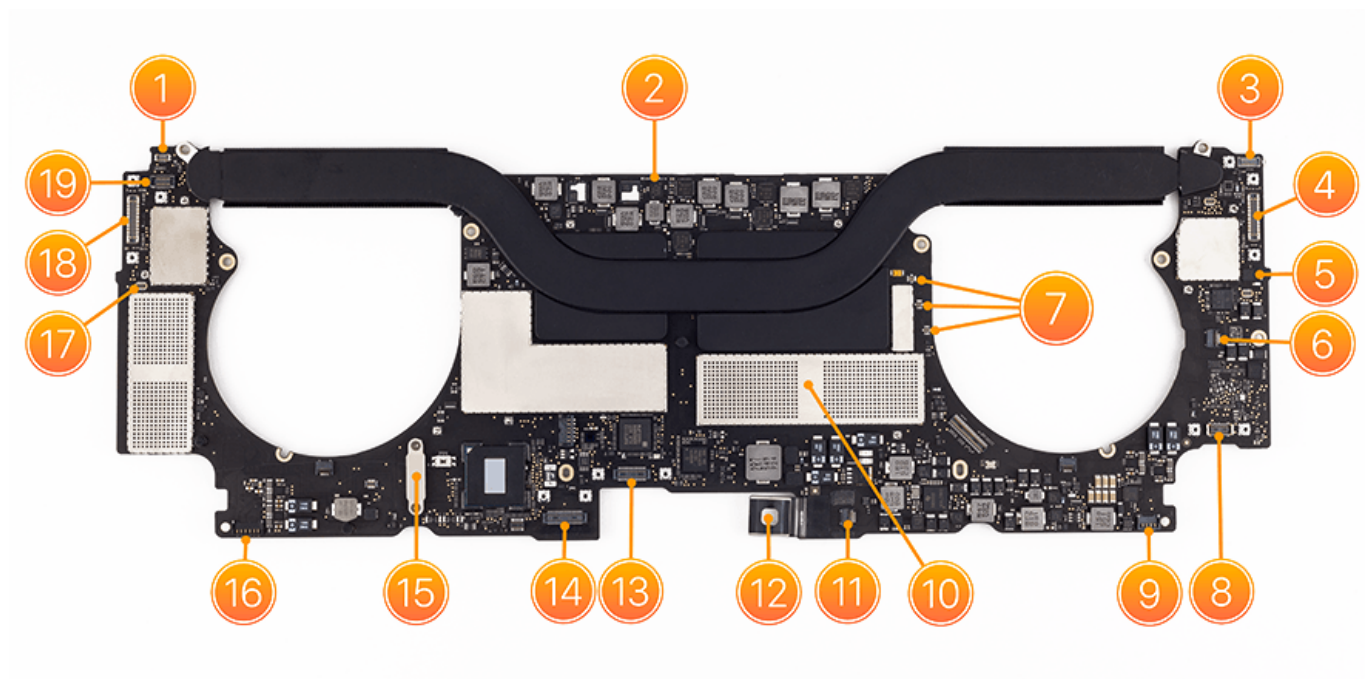
Refer to this diagram to see how modules are interrelated. Click on the image to enlarge.



Functional Overview

Functional Overview for MacBook Pro (15-inch, 2016 and 2017)

Refer to this diagram for symptoms related to logic board connectors.



1 = Touch ID flex

- Will not turn on from power button
- Will not authenticate using Touch ID

2 = Embedded DisplayPort (eDP) cable (also carries FaceTime HD camera & Ambient Light Sensor signals)

- No video, blurred, or monochrome video on LCD
- No display backlight
- Open backlight fuse
- Display does not dim in low light conditions
- Keyboard backlight cannot be enabled
- Camera does not function

3 = Touch Bar Touch flex cable

- No touch response on Touch Bar

4 = USB-C ports (left)

18 = USB-C ports (right)

- No power
- No battery charge
- Power adapter issues
- USB connectivity issues
- USB power issues
- No video to external display
- No audio to external display speakers
- Thunderbolt device not found
- Thunderbolt controller not recognized
- Thunderbolt driver issue
- Thunderbolt power issues

5 = Left Hall effect sleep sensor flex cable

- No sleep when display closed
- No video to internal display, but video to external display if one is connected (sensor stuck)

6 = Tri-Mic flex cable

- No internal audio input (with Internal Microphone selected in Sound Input Preferences)
- Distorted internal audio input
- No headset controls or mic input

7 = Wi-Fi + Bluetooth antenna connectors

- No/poor Wi-Fi reception
- Drops Wi-Fi connection
- Does not pair with Bluetooth devices
- Drops Bluetooth connection

8 = Touch Bar Display flex cable

- No video, blurred, or monochrome video on Touch Bar display

9 = Left speaker

- No/distorted audio from left speaker

10 = Onboard Memory (soldered on bottom of logic board)

- Three beep tones on startup
- Freeze or kernel panic
- Horizontal video lines

11 = Battery (BMU signal flex)

- Not running when on battery only
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar
- Battery removed - extended time before startup and fan running at full speed

12 = Battery (BMU power flex and BMU interconnect screw)

- Not running when on battery only
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar
- Battery removed - extended time before startup and fan running at full speed

13 = Keyboard flex cable (also carries keyboard backlight controls and fan power)

- Non-responsive keys
- No keyboard backlight
- Fan not running

14 = Trackpad flex cable (also carries keyboard backlight controls)

- No Multi-Touch or cursor movement from built-in trackpad
- No click action from built-in trackpad
- No keyboard backlight

15 = Customer Data Migration (CDM) Tool jumper connector

- Flash Storage device not visible in System Information
- OS boot failure from internal flash storage
- No access to internal flash storage

16 = Right speaker

- No/distorted audio from right speaker

17 = Right Hall effect sleep sensor flex cable

- No sleep when display closed
- No video to internal display, but video to external display if one is connected (sensor stuck)

18 = USB-C ports (left) identical to 4 = USB-C ports (right)

19 = Audio board flex cable

- No internal audio input (with Internal Microphone selected in Sound Input Preferences)

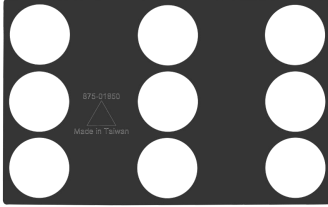
- No external analog audio/digital optical output
- No headset controls or mic input

Trackpad Calibration Check

For video instruction, refer to article [SV279: Force Touch Trackpad Calibration Check Video](#).

Required tools:

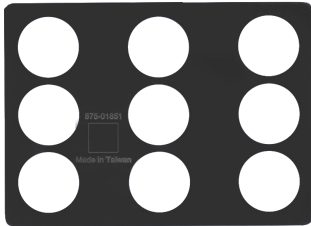
- Weight Placement Rubber Template (923-00555)
 - MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)



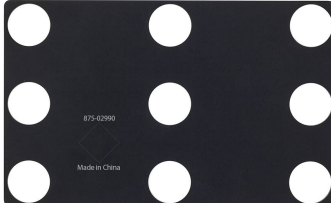
- Weight Placement Rubber Template (923-01316)
 - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)
 - MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports)



- Weight Placement Rubber Template (923-00599)
 - MacBook Pro (Retina, 13-inch, Early 2015) and (Retina, 15-inch, Mid 2015)



- Weight Placement Rubber Template (923-01317)
 - MacBook Pro (15-inch, 2016 and 2017)



Note: Weight Placement Rubber Templates come in a pack of three. If the edges start to curl, it is necessary to order a new pack.

- 200g and 800g weights (923-00462)



Steps:

To verify that the trackpad is responding as expected, the technician must run the Trackpad Calibration Check after every repair or whenever the computer has been reassembled.

Note: It is recommended to also run the Trackpad Response test after a top case with keyboard has been replaced, or if the user is having issues related to trackpad functionality.

1. Place the Weight Placement Rubber Template on the trackpad before launching the test in AST 2. This establishes the correct baseline for the weights.

Important: The Weight Placement Rubber Template does not need to be taped to the top case. Tape may cause inaccurate test results.



2. Launch AST 2. In Diagnostic Console, select Trackpad Calibration Check from the list of diagnostic suites. For more information on AST 2, refer to article [TP1279: AST 2: Supported Products and Tests](#).

Caution: The Trackpad Calibration Check is very sensitive to external disturbances. The test should be run on a flat surface. Do not run the diagnostic on a bench where other technicians are working. To avoid interfering with the results, be sure to place weights down gently on a separate surface while running the diagnostic. If the computer is bumped or jostled while the diagnostic is running, the technician will have to begin the test again.

[< Diagnostic Results](#)

Diagnostic Suites

TRIAGE



Trackpad Response

Assists in verifying functionality of trackpad.



3 minutes



REPAIR



Trackpad Calibration Check

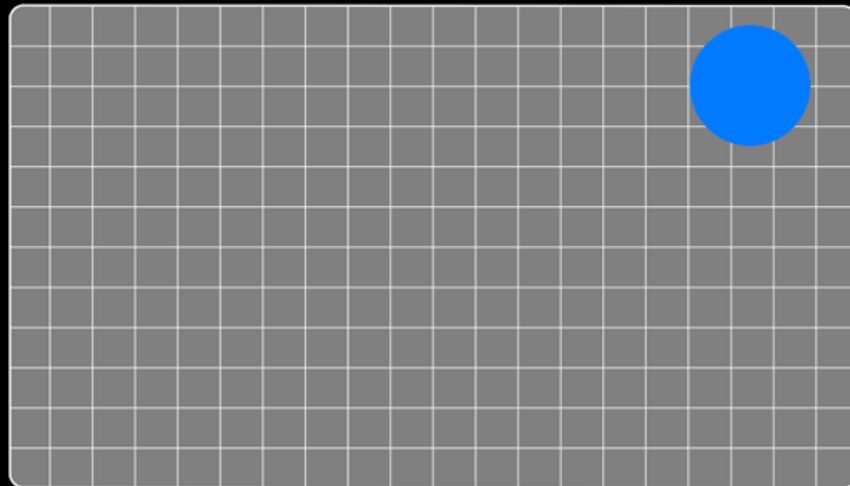
Verifies calibration of the trackpad actuator and force sensor.



3 minutes

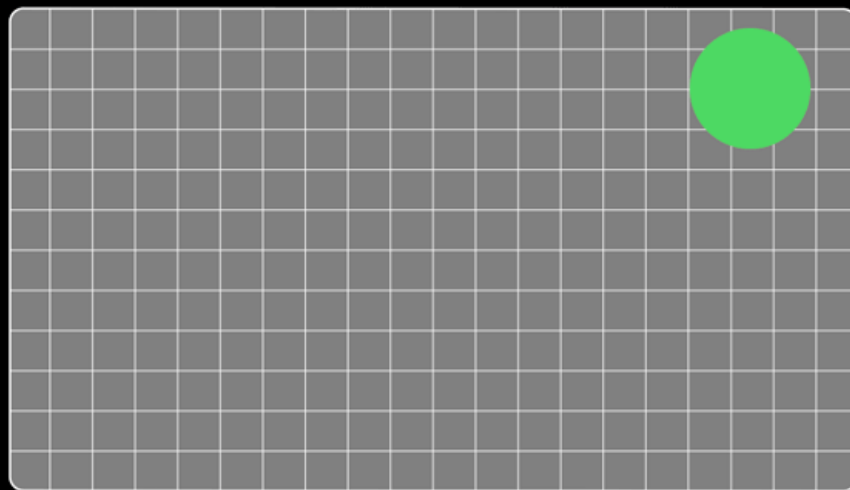


3. The diagnostic suite consists of several stages. The first stage of the suite is the Force Check, which is interactive and requires the technician to place the 200g and 800g weights as indicated. The blue dot will indicate where to place each weight on the trackpad. The text at the bottom of the screen will indicate which weight to use at each step. The dot will turn green when it is time to lift the weight from the trackpad.



Test Instruction

Place the 200g weight on the indicated area and press any key.



Test Instruction

Remove the weight from the indicated area and press any key.

4. The next stage is the Actuator Check. During this stage, the trackpad will make clicking sounds while the actuator is tested. If any issues with the actuator are identified, the test may need to proceed to the next stage, which is the Actuator Calibration. The trackpad will continue to make clicking sounds while the actuator is calibrated. During this process, the unit under test (UUT) will display the screen shown below.

Checking your Mac...



Restart

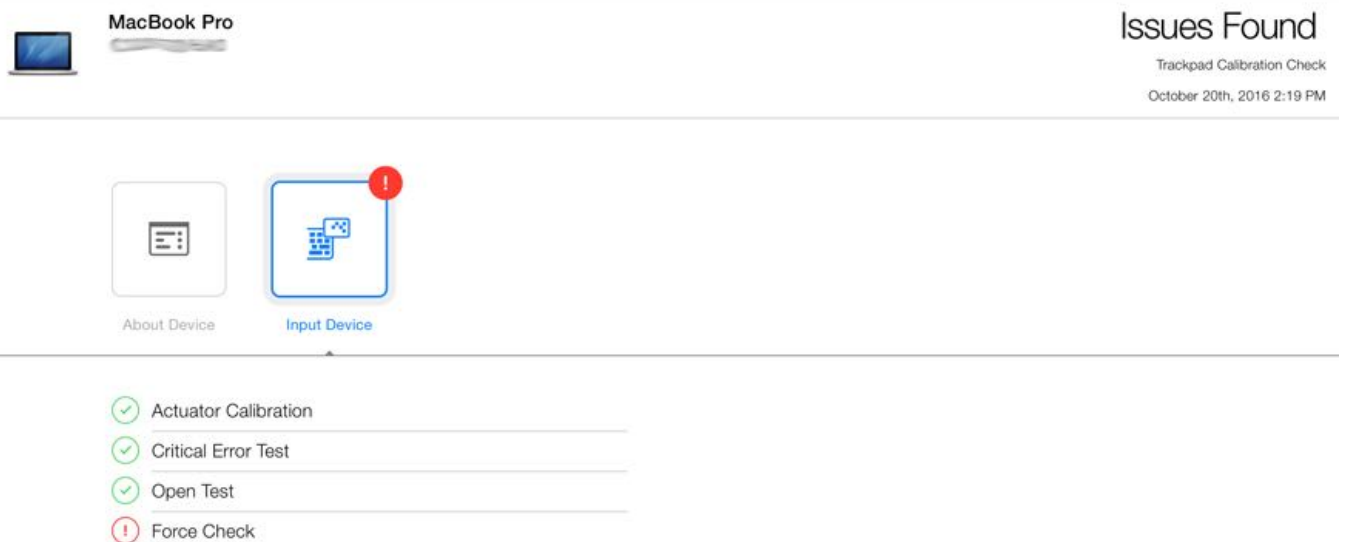


Shut Down

5. If no issues are found, the screen will look like the image below. The trackpad calibration is verified.



6. If issues were found in the Actuator Check, the Actuator Calibration, or the Force Check, the screen will look like the image below and the suite should be run again. If the computer fails a second time, a top case with keyboard replacement is recommended.



Connector Types on Logic Board

Connector Types on Logic Board for MacBook Pro (2016 and 2017)

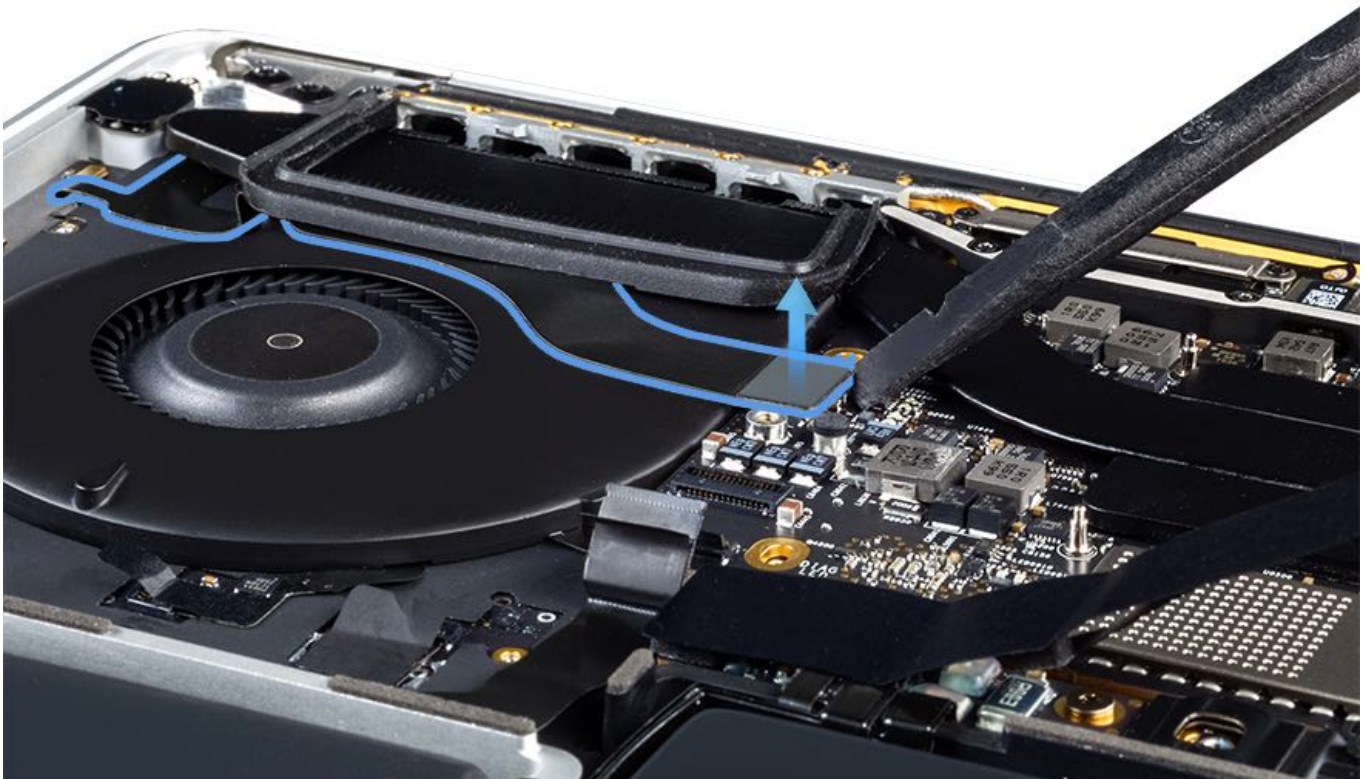
Low-Profile Solid Platform Flex

- Disconnect connector vertically in one motion. The connectors are susceptible to bent pins if rocked side-to-side or inserted improperly.
- Reconnect connector by first aligning it over receptacle. Keep connector level with board and press down evenly.

Example:

- audio flex cable
- trackpad flex cable
- Embedded DisplayPort (eDP) flex cable

[Low-Profile Solid Platform Flex Video](#)



Locking Lever

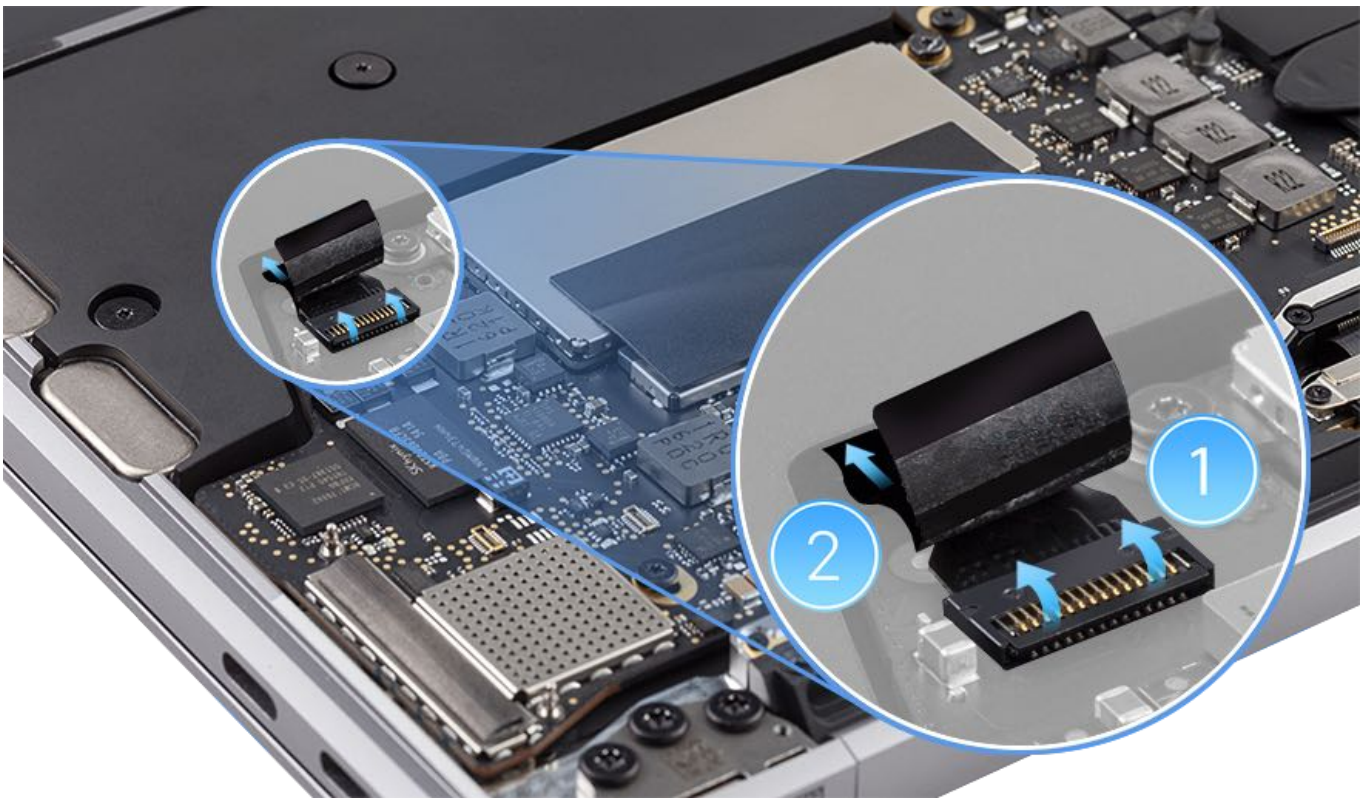
- Flip up lever 90 degrees and evenly disconnect cable.
- Lock down lever after inserting cable.
- Close lever when handling or shipping a logic board module, whether a known-good or a known-bad board.

Example:

- speakers
- keyboard flex cable
- fan
- battery flex cable

Caution: The locking levers on the logic board are fragile. To protect the levers during handling or shipment of the logic board, close the levers after the cables are disconnected. Once the logic board is installed in the top case and the cables are connected, be sure to lock down the levers again.

[Locking Lever Video](#)



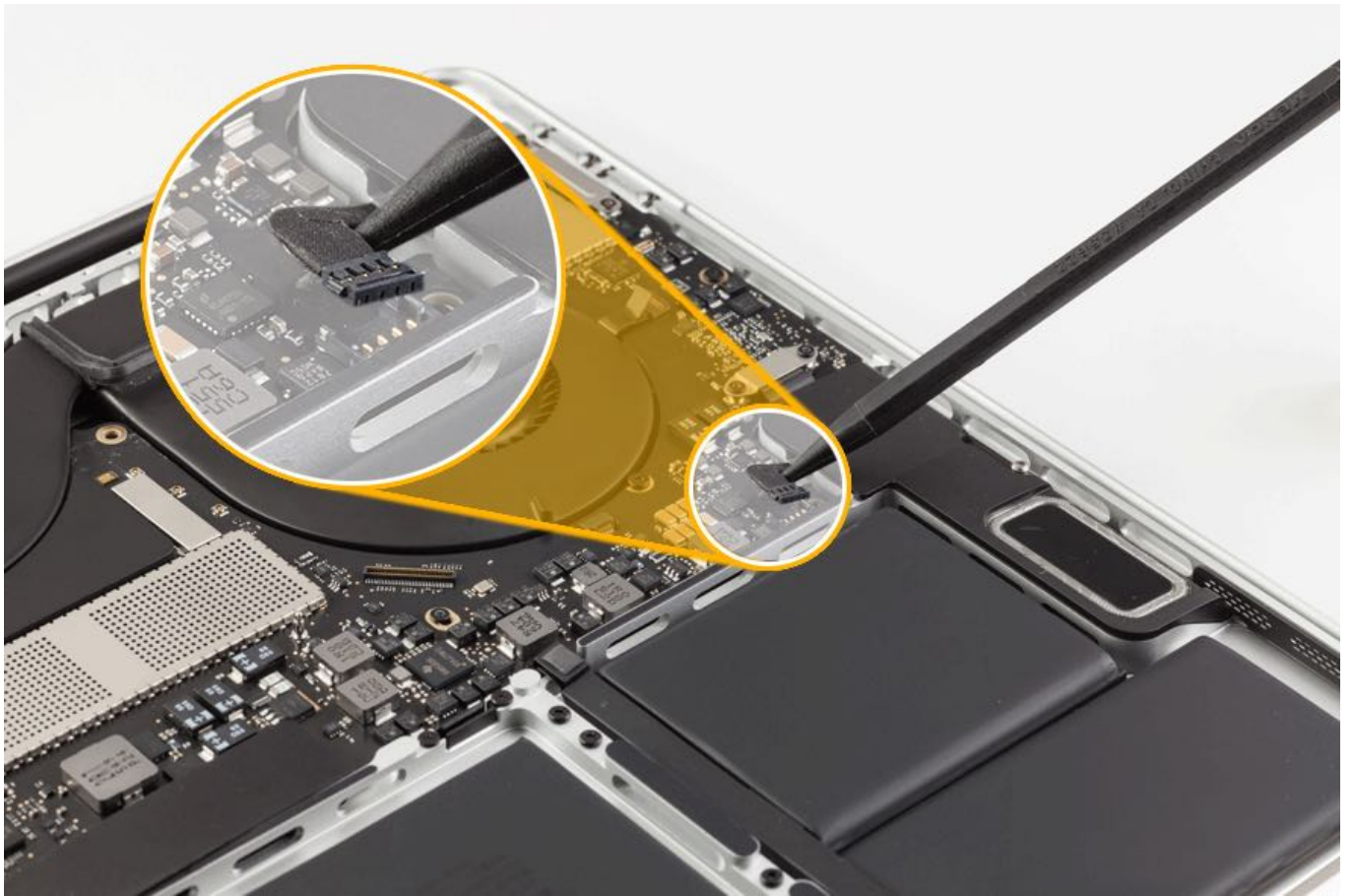
Vertical Insertion (JST)

MacBook Pro (15-inch, 2016 and 2017) only

Example:

- Use a black stick under the cable to remove.
- Keep the connector level to the board when disconnecting and reconnecting.
- Press evenly when reconnecting or connector can be tipped up and not fully seated.
 - Right speaker
 - Left speaker

[Vertical Insertion \(JST\) Video](#)



Tools and Fixtures

Tools and Fixtures for MacBook Pro (2016 and 2017)

The following tools are required:

- Clean, soft, lint-free cloth
- ESD-safe workstation, including an ESD mat and wrist or heel strap
- ESD bags (for storing ESD-sensitive parts while removed from the unit)
- ESD-safe tweezers for wireless cables or antenna tool (923-01322)
- Suction cup (922-8252)
- Pentalobe screwdriver (923-0731)
- Torque driver (blue), 0.65 kg-fcm (923-0448)
- 1IPR security bit (923-0247), use with the Torque driver (923-0448)
- Torx T3 screwdriver (magnetized)
- Torx T4 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- Torx T8 screwdriver (magnetized)
- Black stick or other nonconductive nylon or plastic flat-blade tool (922-5065)
- Thermal grease syringe (922-7144)
- Isopropyl alcohol (IPA) wipe (included with heat sink and logic board)
- Magnifying glass (for reading serial number)
- Keycap lever (923-01803)
- Keycap tool kit (076-00337) includes: Keycap slider tool, keycap lever, Kapton tape, and pre-cut VHB adhesive strips.

Caution: To prevent scratches or other cosmetic damage to the computer housing, use a soft cloth as a protective layer when removing and installing the external screws.

Bottom Case Fixture

- Bottom case removal/install fixture kit (076-00290), which includes:
 - Bottom case fixture
 - Quick grip clamps (2), also available separately (923-01369)
 - Non-slip gloves, small (pair), also available separately (923-01371)
 - Non-slip gloves, extra large (pair), also available separately (923-01370)



- Non-slip gloves, medium/large (pair), only available separately (923-01368), not part of the kit

Battery Covers

MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): **923-01318**



MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): **923-01319**



MacBook Pro (15-inch, 2016 and 2017): **923-01320**



Trackpad Tools

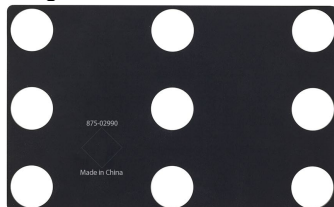
- Trackpad calibration weights (923-00462)



- Weight Placement Rubber Template (923-01316) for MacBook Pro (13-inch, 2016 and 2017)

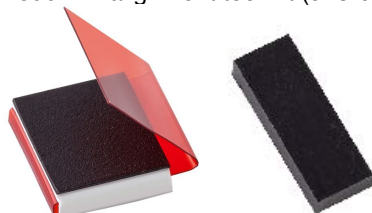


- Weight Placement Rubber Template (923-01317) for MacBook Pro (15-inch, 2016 and 2017)



Other Tools for MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016 and 2017)

- Touch ID alignment tool kit (923-01586)



- Data transfer tool kit (076-00236)



- Logic board holder (923-01130)



Take Apart Procedure Notes

Reassembly Steps

When no replacement steps are listed, replace parts in exact reverse order of Removal procedure.

Note About Images in This Guide

In some cases a pre-production model may have been used to document the procedures in this guide. Although there may be small differences in appearance between the image pictured and the computer you are servicing, the procedures are the same unless noted.

Screw Sizes

All screw sizes shown are approximate and represent the total length of the screw.



Bottom Case

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Follow ESD guidelines. Refer to article [OP100: Electrostatic Discharge Precautions and Myths](#).
- Read article [TP772: Battery Safety Setup](#) before performing this procedure.

Before you begin:

- Disable the auto boot features. Refer to article [TP1484: Auto Boot](#).
- Shut down the computer.
- Unplug all cables.
- Once the display has turned off, press the Caps Lock key and verify that the LED does not turn on.
- Put on an ESD wrist strap.
- Place the computer face down on a clean, flat surface.

For video instruction, refer to article [SV306: Bottom Case Replacement Video](#).



Tools


- ESD wrist strap
- Clean, soft, lint-free cloth
- Pentalobe screwdriver (923-0731)

- Battery cover:
 - 923-01318 for MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)
 - 923-01319 for MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports)
 - 923-01320 for MacBook Pro (15-inch, 2016 and 2017)
- Bottom case removal/install fixture kit (076-00290)
- Fine-tip permanent marker
- Suction cup (922-8252)

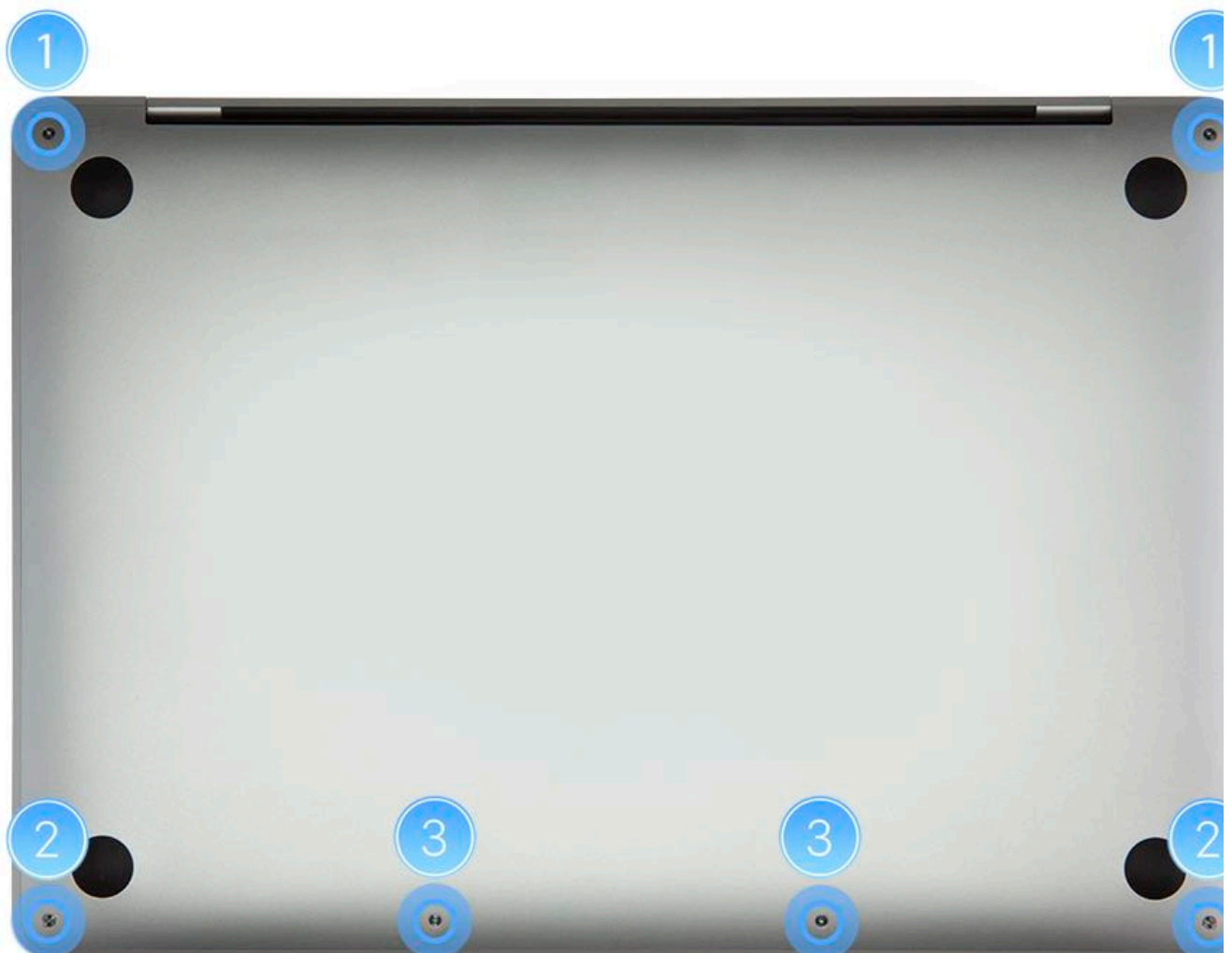


Steps For Removal

1. Remove the six Pentalobe screws following any sequence. The difference in screw lengths is only important when replacing them.
Note: In the following table, "2 TBT3" refers to the MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports) models, and "4 TBT3" refers to the MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports) models.

	Screw #1	Screw #2	Screw #3
13-inch, 2 TBT3 Space Gray	923-01299 	923-01097 	923-01095 
13-inch, 2 TBT3 Silver	923-01099 	923-01100 	923-01098 
13-inch, 4 TBT3 Space Gray	923-01096 	923-01413 	
13-inch, 4 TBT3 Silver	923-01415 	923-01431 	
15-inch Space Gray	923-01514 	923-01513 	
15-inch Silver	923-01517 	923-01516 	

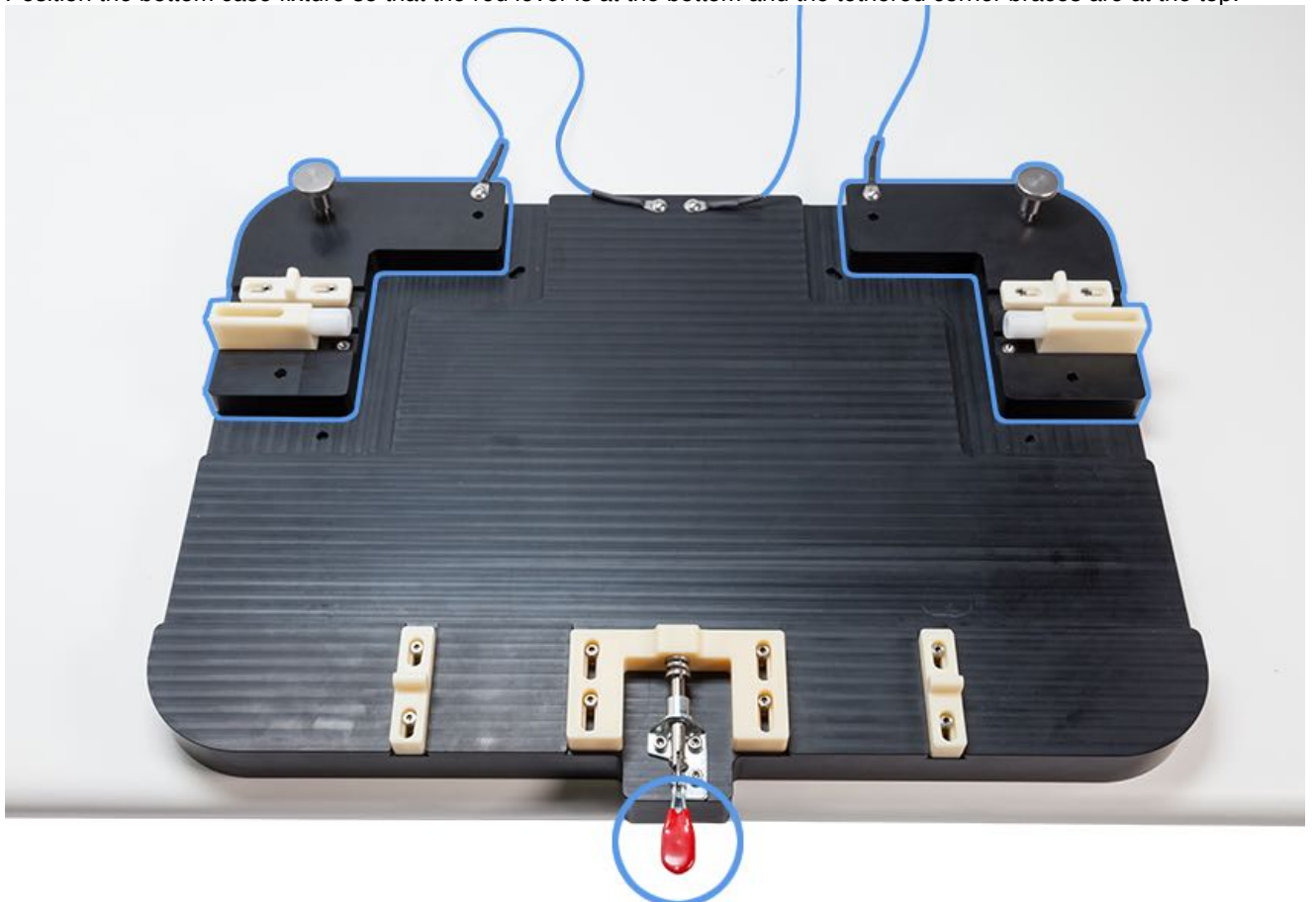
MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)



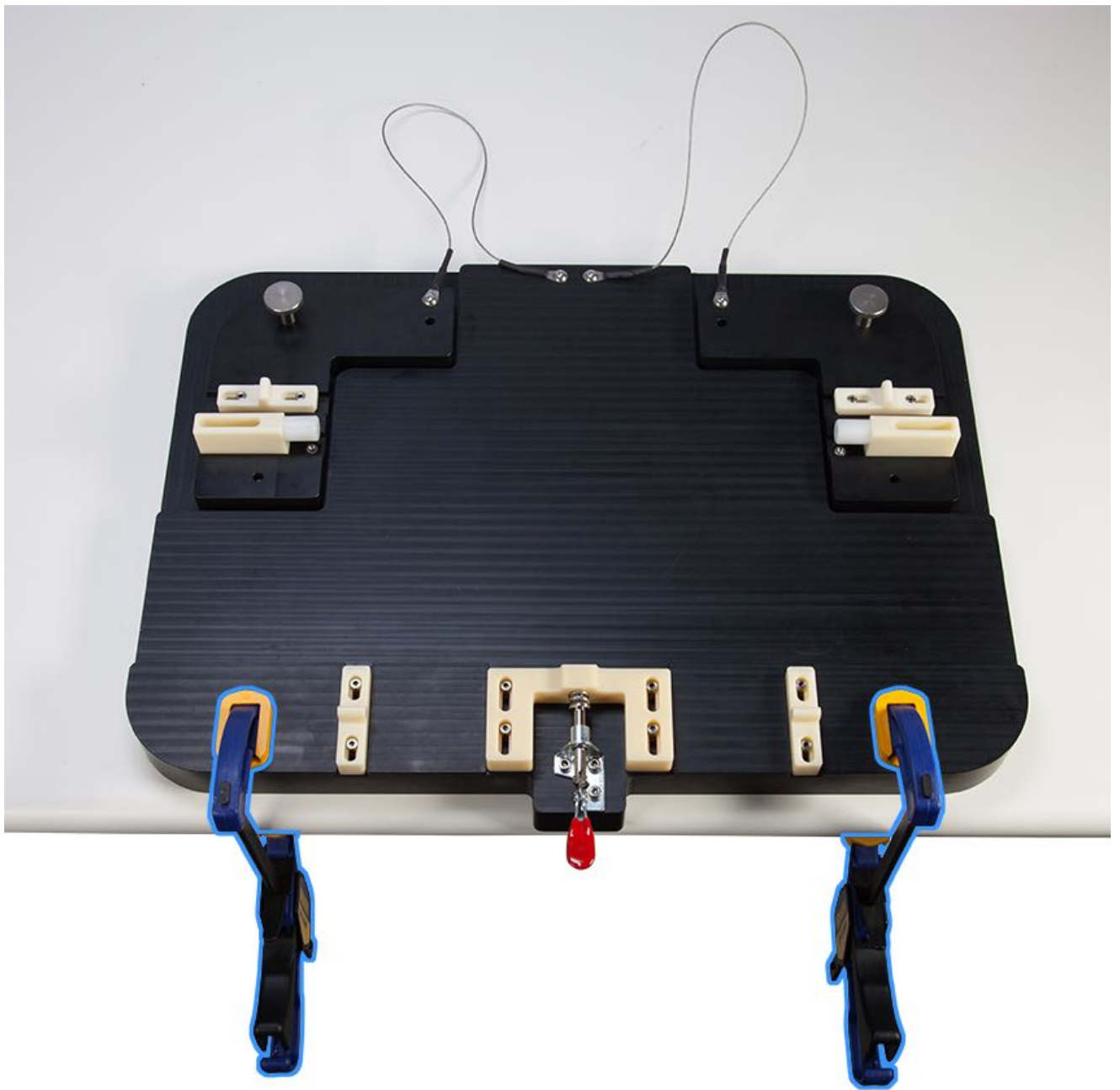
MacBook Pro (13-inch, 2016, and 2017 Four Thunderbolt 3 Ports) and (15-inch, 2016 and 2017)



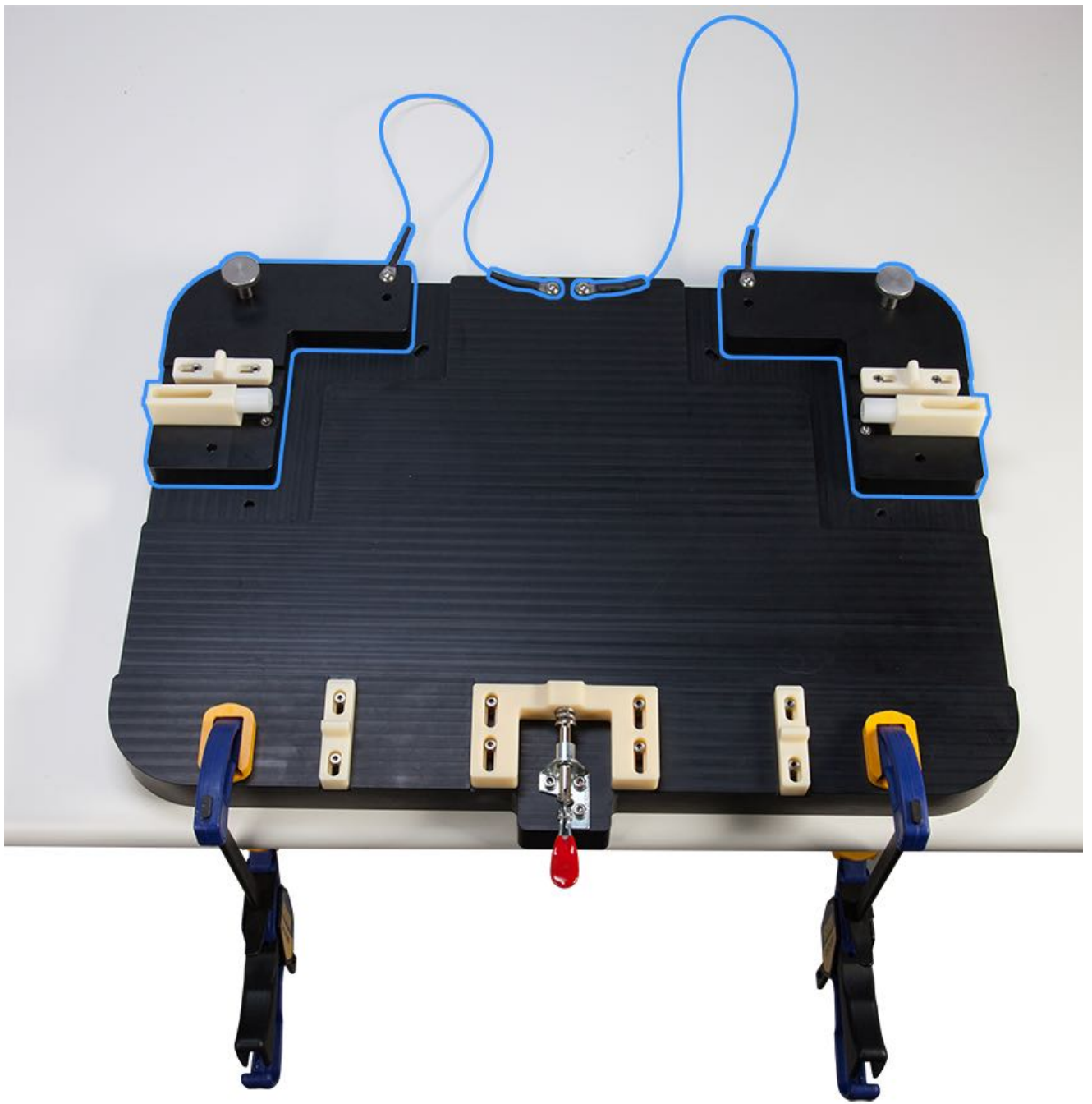
2. Position the bottom case fixture so that the red lever is at the bottom and the tethered corner braces are at the top.



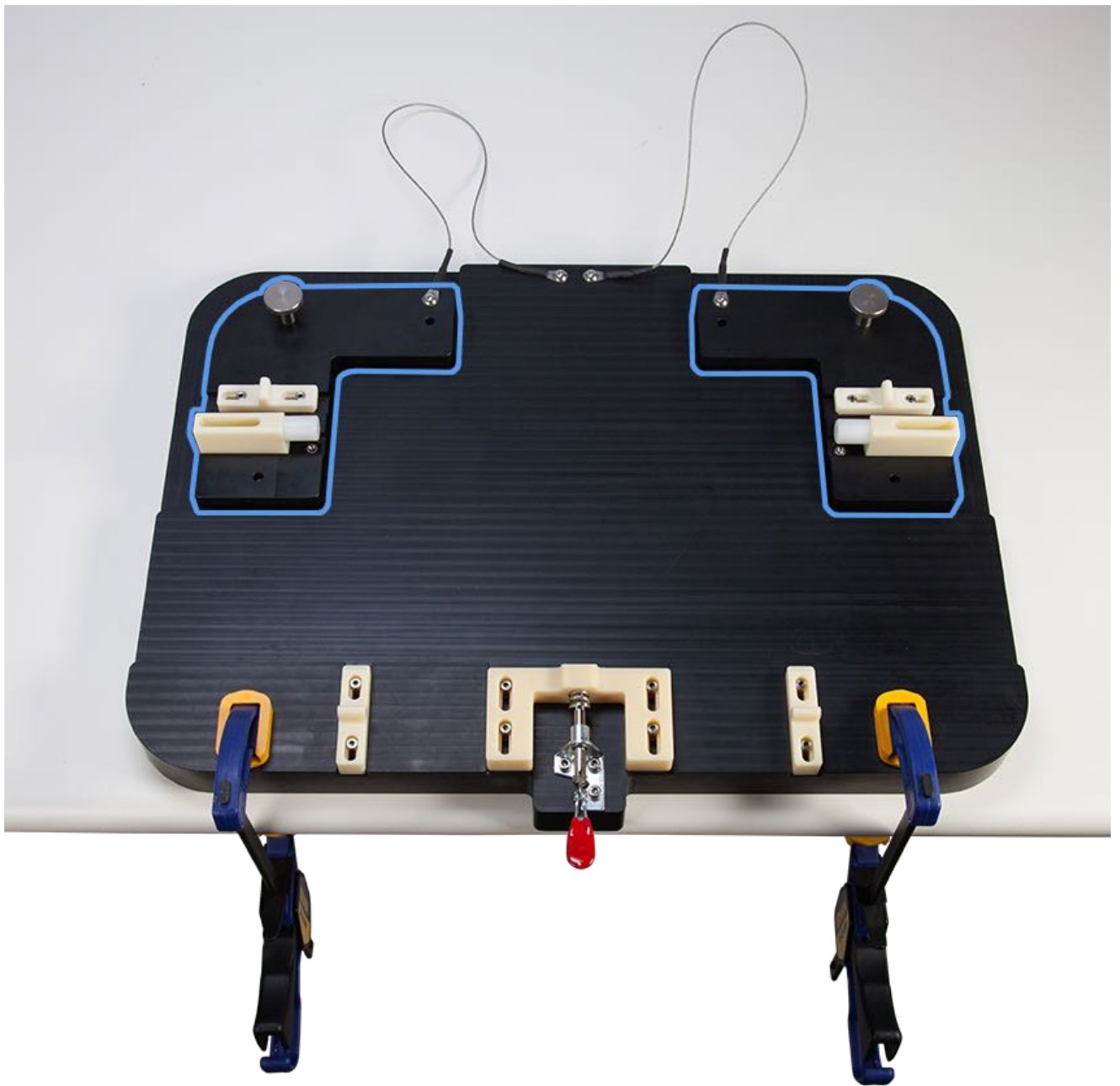
3. Use two Quick Clamps to secure the bottom case fixture to the table. Squeeze the clamp handles to tighten them. Make sure that the sliding bars of the clamps are below the table.



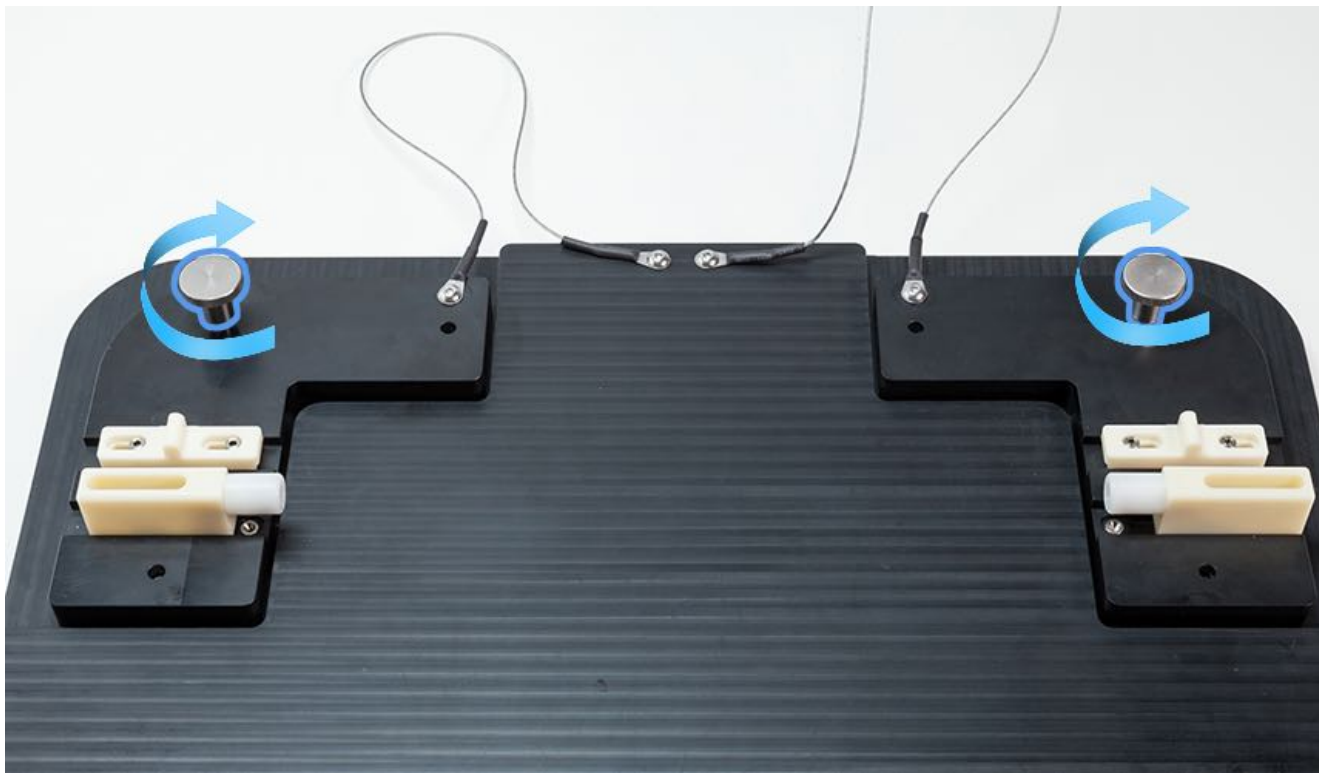
4. Unscrew and position the corner braces to accommodate either a 13-inch or 15-inch computer. Move the braces outward for a 15-inch model, as shown.



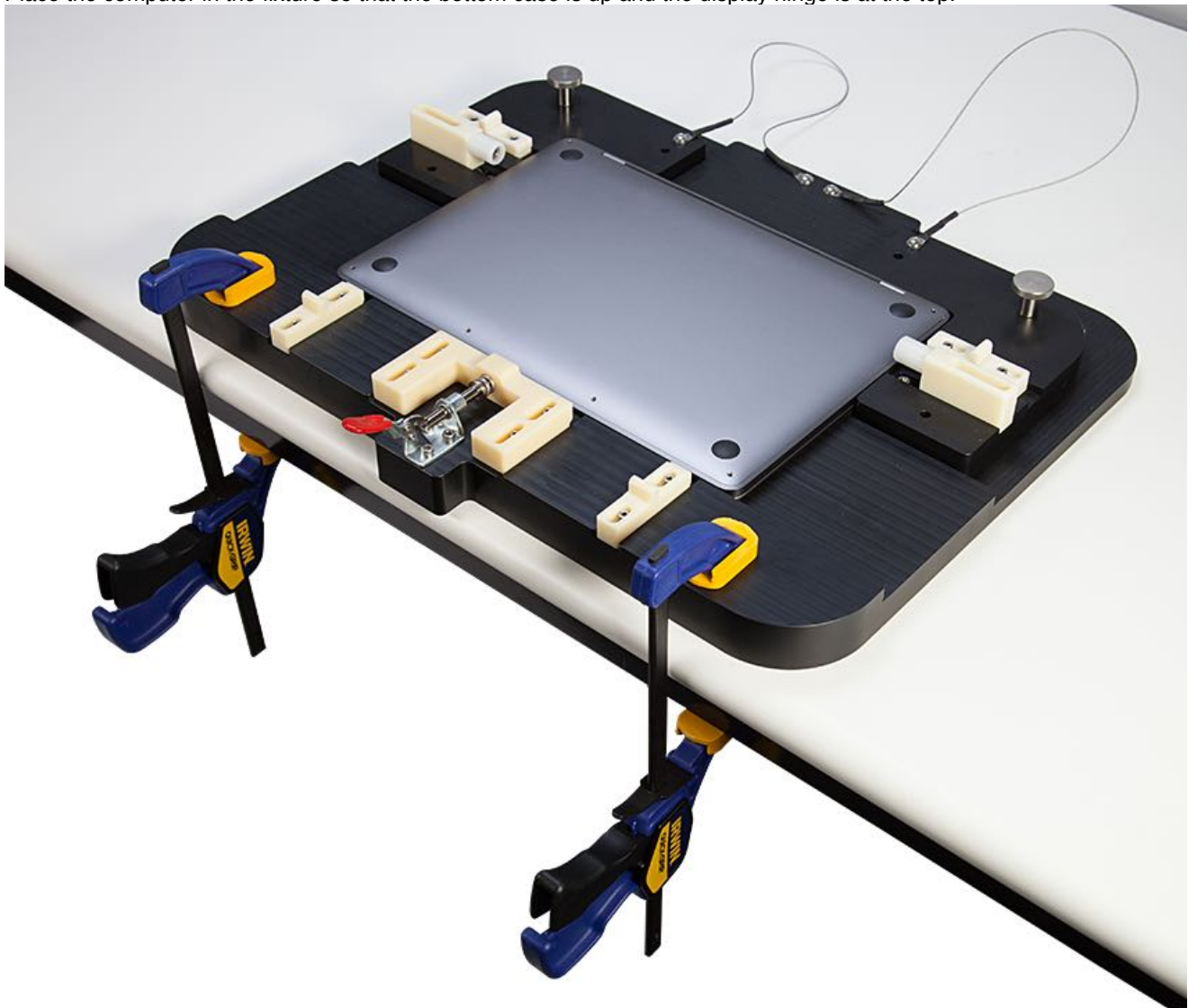
5. Move the braces inward for a 13-inch model, as shown.



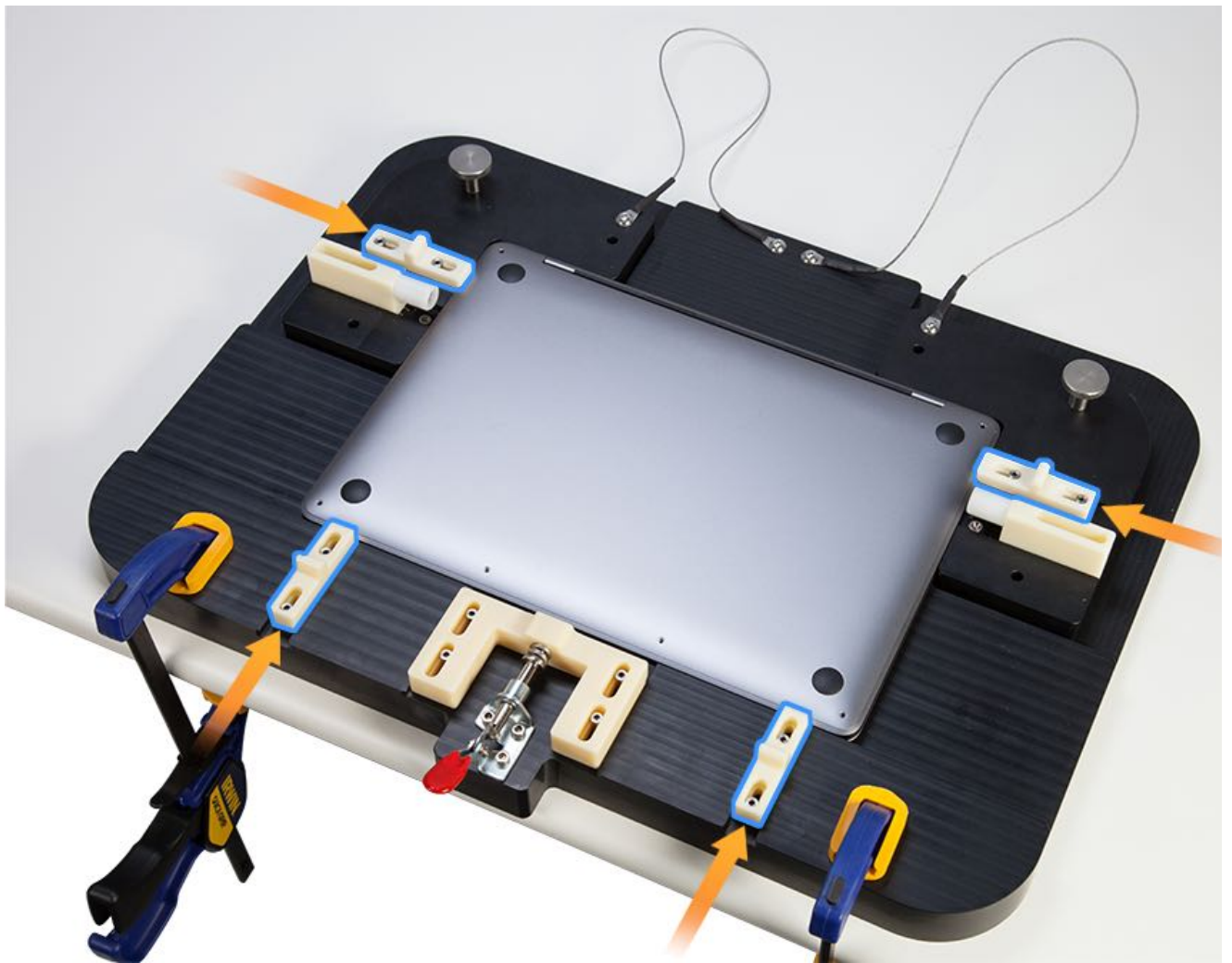
6. Once the corner braces are set, tighten the silver thumbscrews.



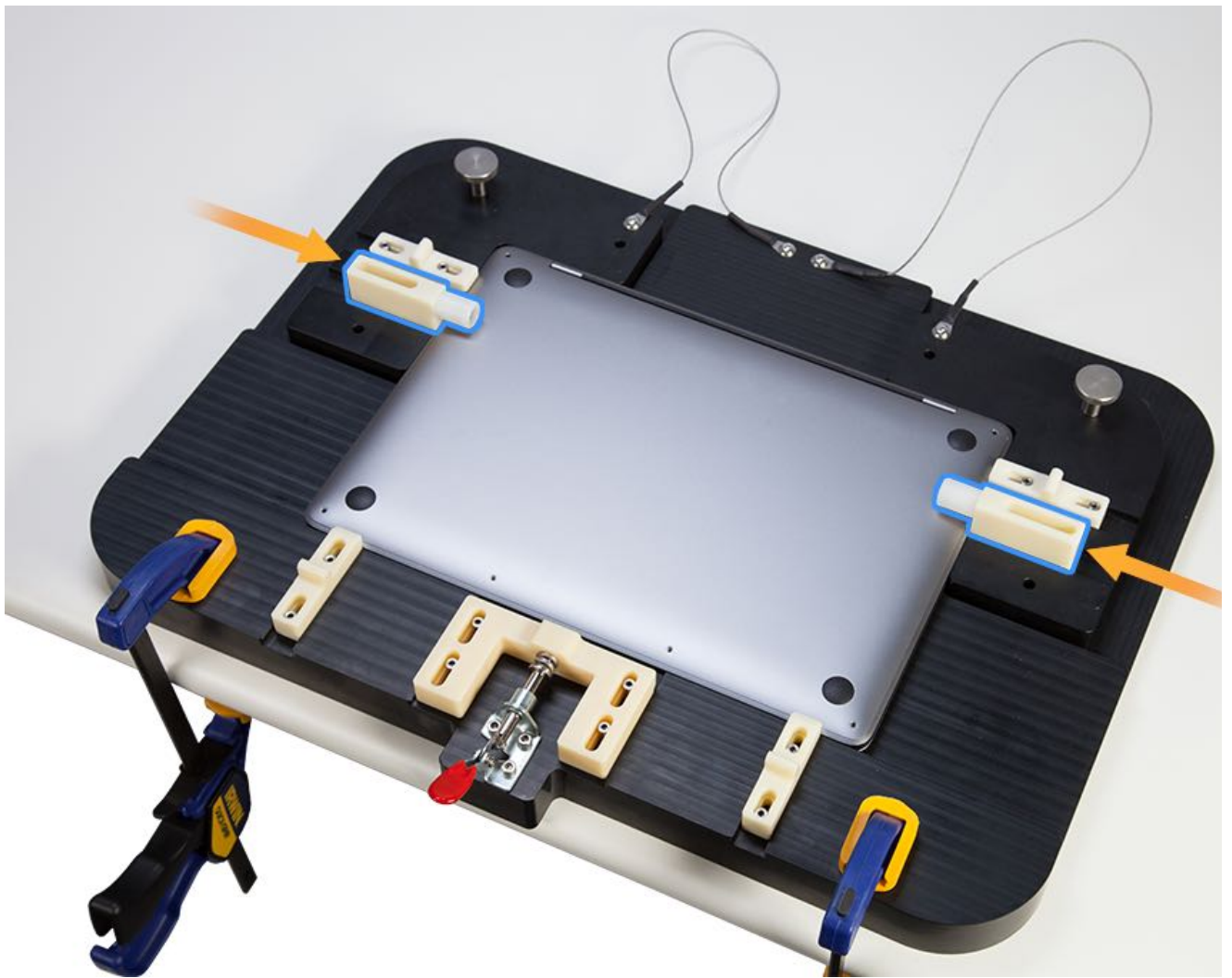
7. Place the computer in the fixture so that the bottom case is up and the display hinge is at the top.



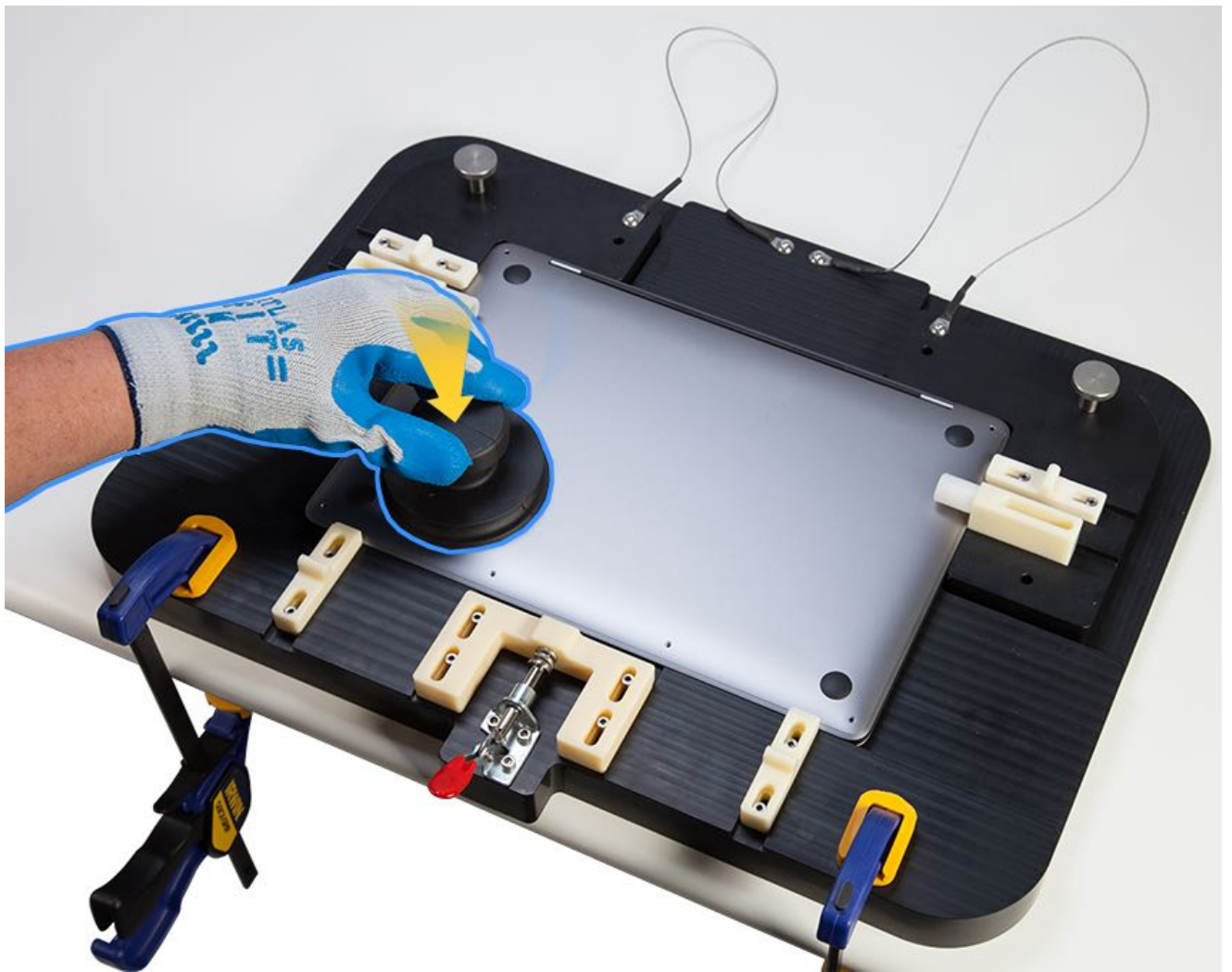
8. Push the four sliding locks inward to hold the computer in place.



9. Press the two rollers inward. They prevent the bottom case from tilting upwards too far.

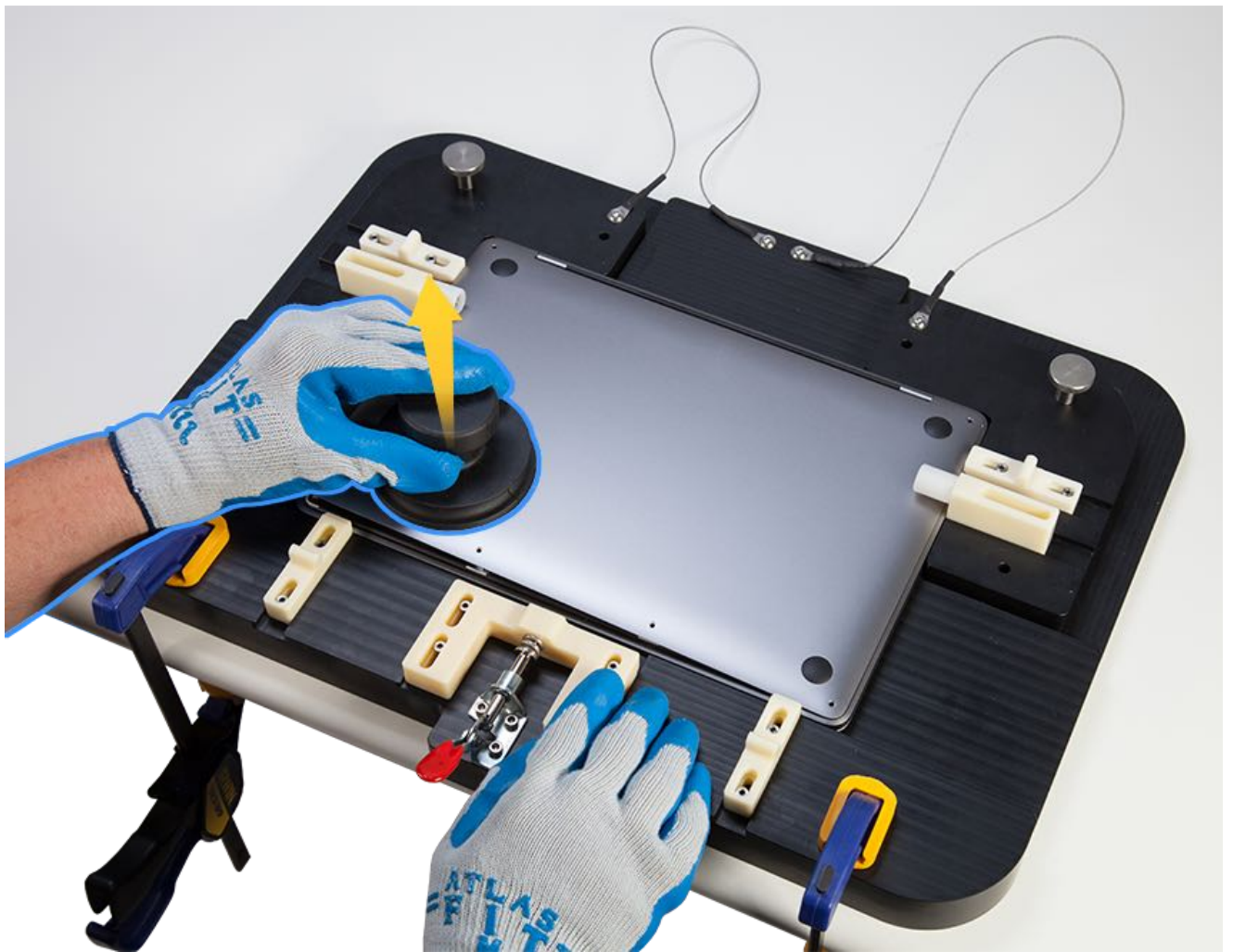


10. Put on the pair of gloves and attach the suction cup at the lower left edge of the bottom case.



11. Pull up on the suction cup about half a centimeter (0.5 cm), just high enough to lift the bottom case and release two snaps.

Caution: Do NOT insert a black stick into the opening. Using a black stick could damage the battery.



12. Move the suction cup to the lower right corner.



Pull up the suction cup to release the remaining two snaps.

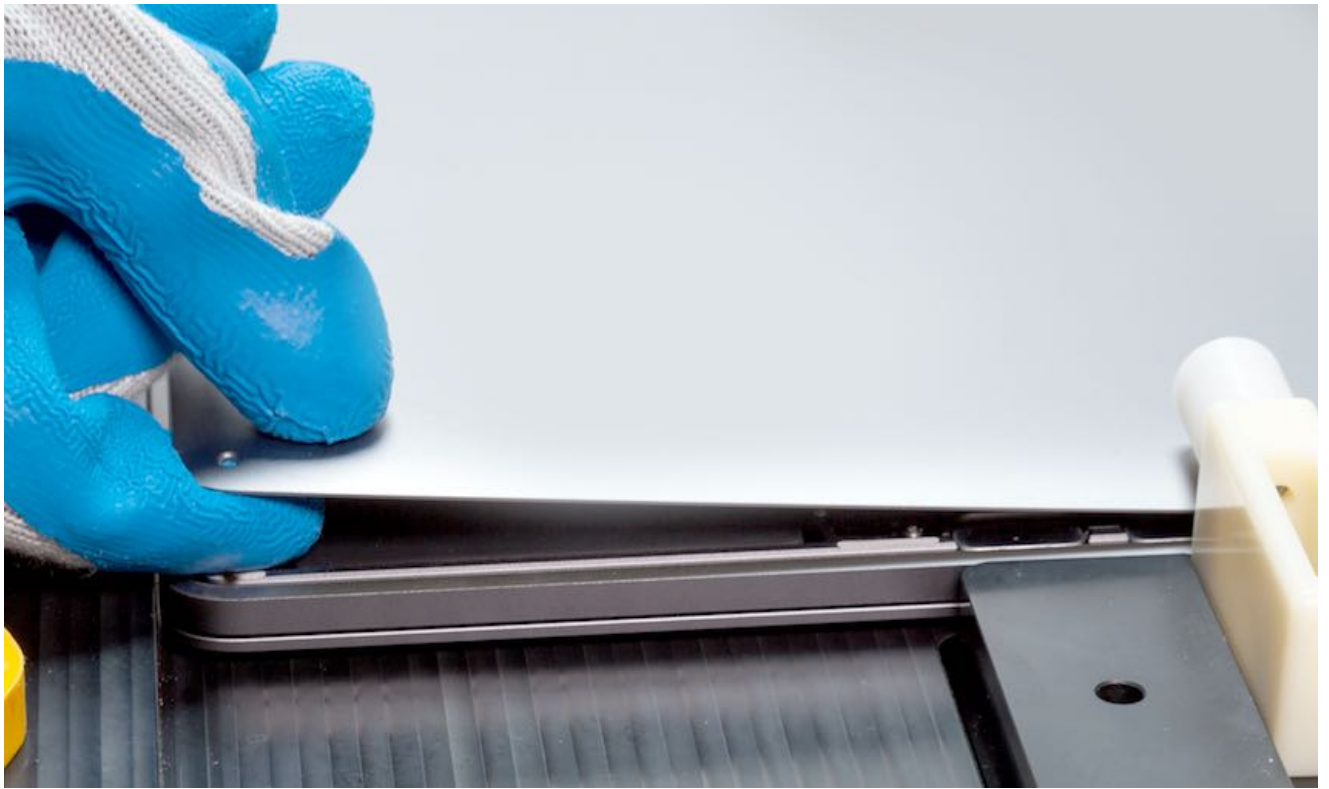
13.



14. Remove the suction cup. Then insert your index fingers into the narrow opening at the front of the computer.



15. To protect the computer assembly, keep the opening no more than a finger's width.



16. Position both hands so that they are braced in the recessed areas of the fixture. Bracing your hands allows more leverage and protects the internal components when you remove the bottom case.



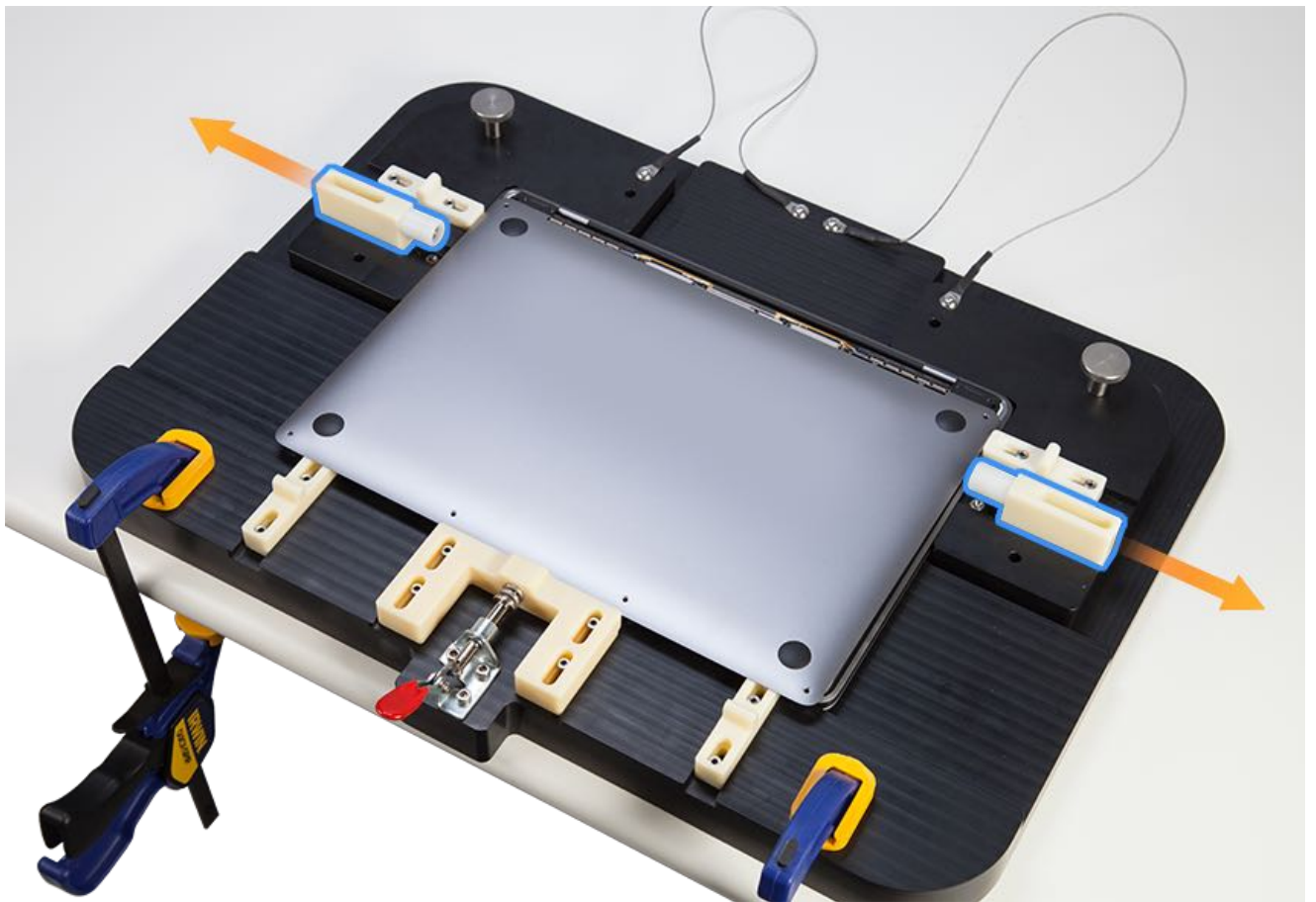
17. Pull the bottom case toward you.
Caution: The spring fingers that secure the bottom case can release suddenly. To prevent the bottom case from sliding over sensitive components, apply gentle and steady pressure to slide the case less than one centimeter (< 1 cm).



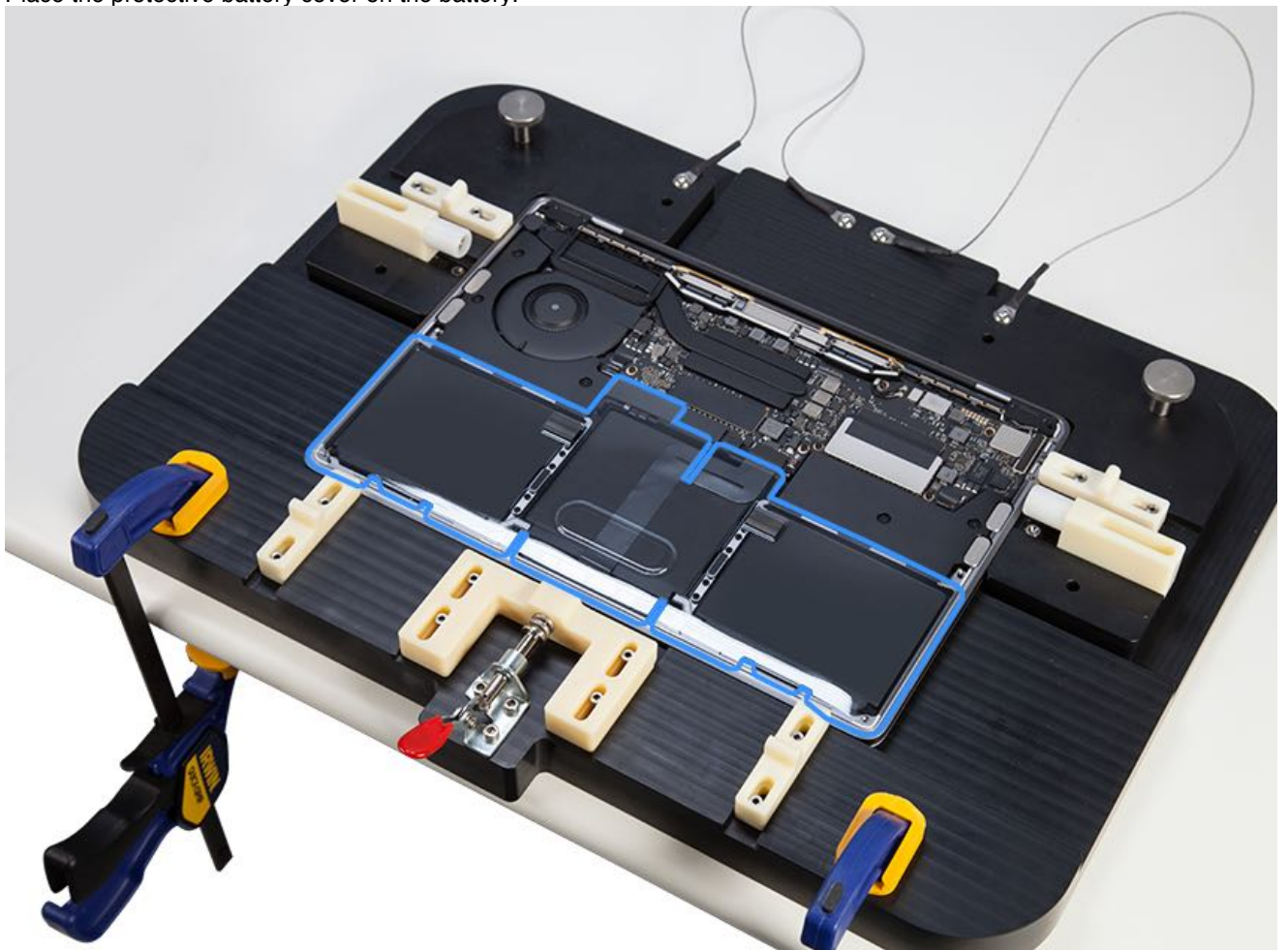
18. Once the spring fingers are disengaged, let the bottom case rest on the computer assembly.



19. Remove the gloves and disengage the two rollers.
20. Remove the bottom case from the fixture.



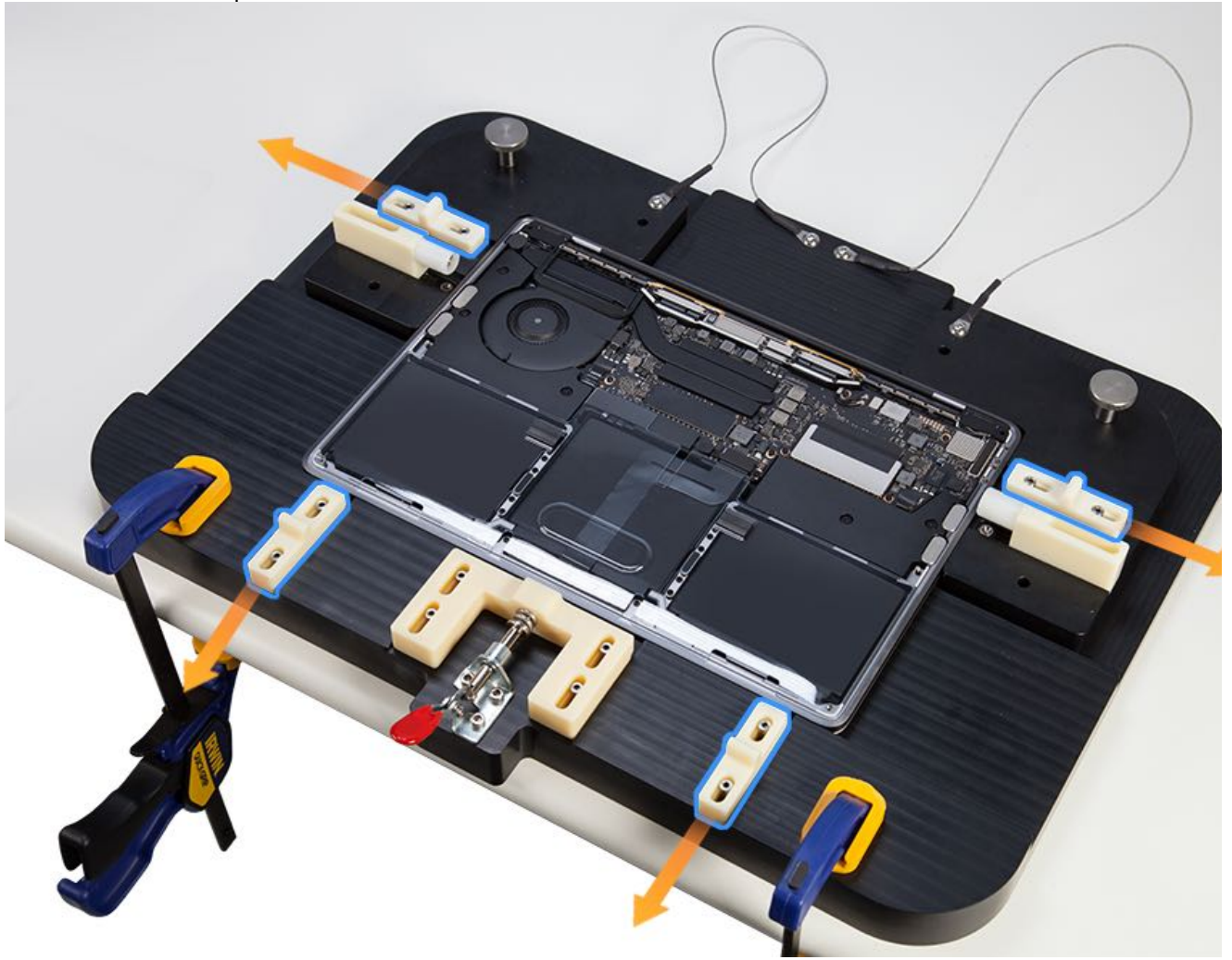
21. Place the protective battery cover on the battery.



22. If you are replacing just the bottom case, go to the Reassembly instructions. If you are performing an additional repair on the computer, do not perform that repair while the unit is on the bottom case fixture. Instead, do the following:

- Release the four sliding locks, then lift the computer from the bottom case fixture.

- Transfer the computer to an ESD-safe surface.



23. Refer to one of the following articles to disconnect the battery:

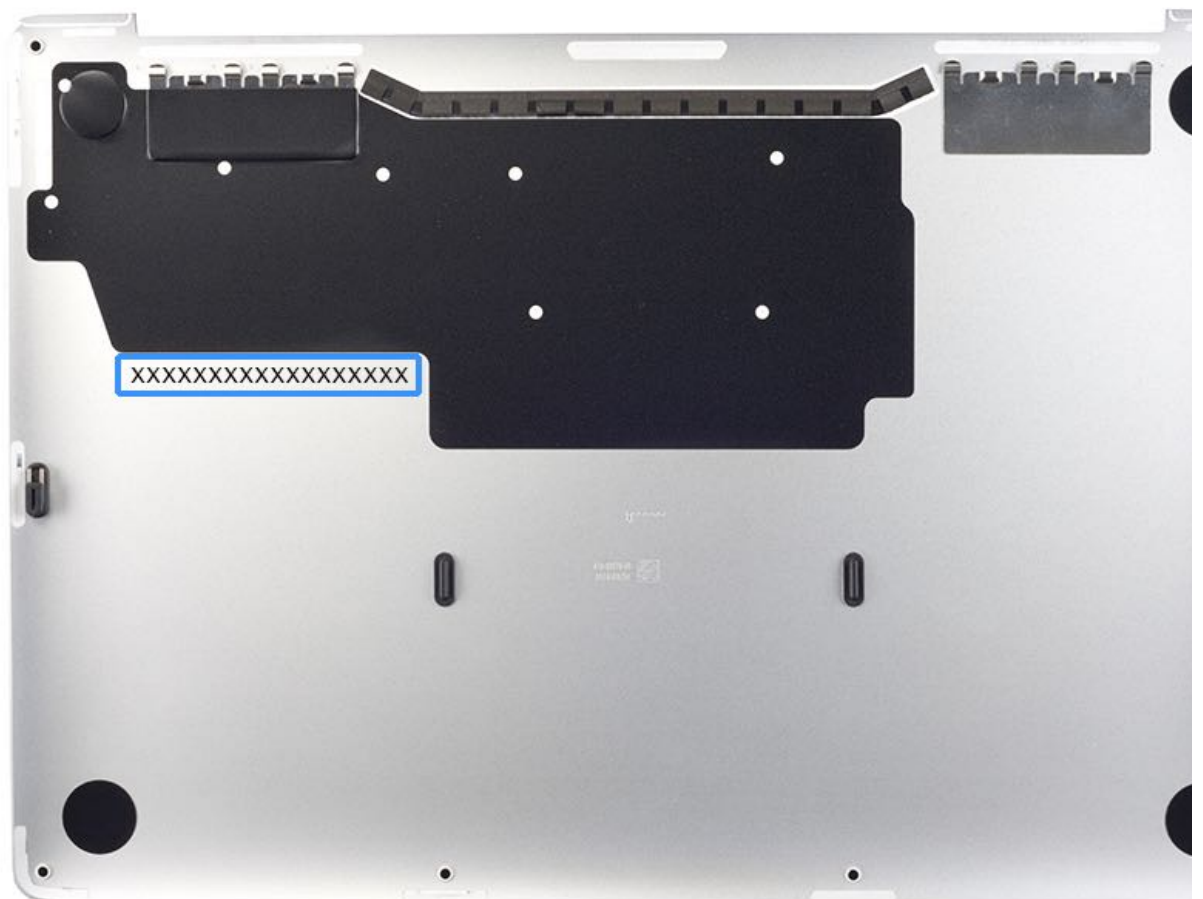
- [MacBook Pro \(13-inch, 2016 and 2017, Two Thunderbolt 3 Ports\): Battery Cover and Disconnecting the Battery](#)
- [MacBook Pro \(13-inch, 2016 and 2017, Four Thunderbolt 3 Ports\): Battery Cover and Disconnecting the Battery](#)
- [MacBook Pro \(15-inch, 2016 and 2017\): Battery Cover and Disconnecting the Battery](#)

Steps For Reassembly

1. Before installing a new bottom case, do the following:
 - Check the replacement bottom case for a red tube that runs through the air loops. Grasp one end of the red tube and pull it out of the air loop strip. The tube is used only during shipment and should be discarded.

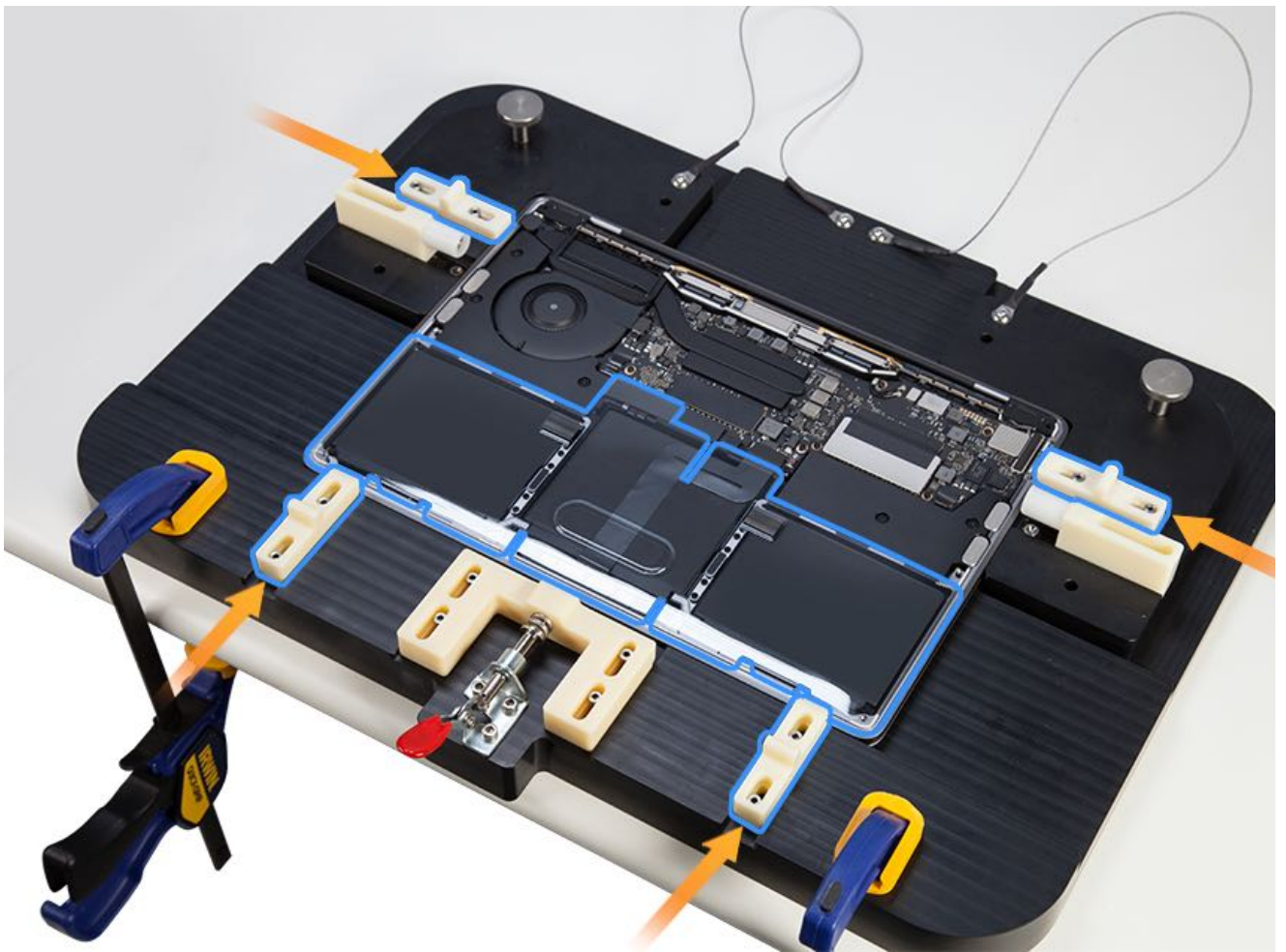


- Retain the original bottom case until the repair is complete. Write the system serial number on the inside of the replacement bottom case. You might need a magnifying glass to read it.

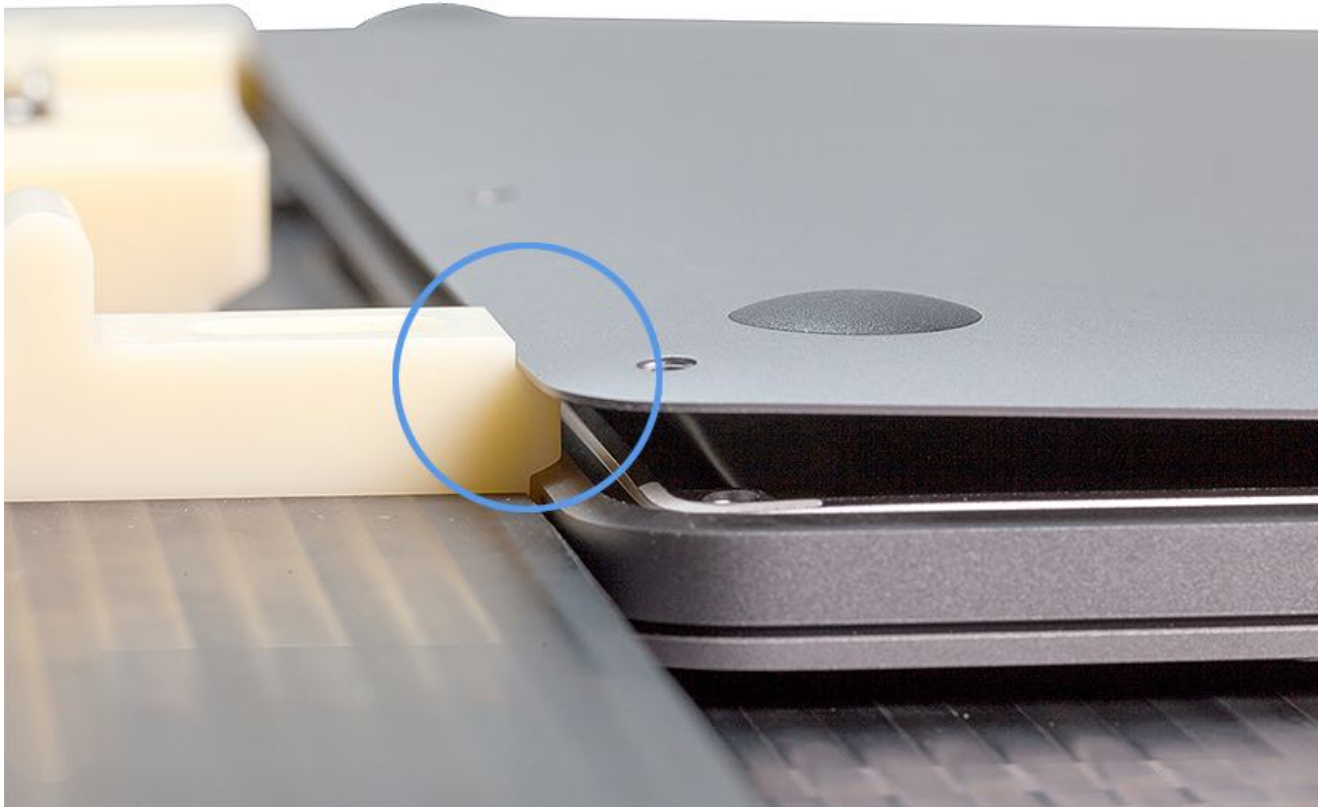




2. Reconnect the battery cable. Then place the computer on the bottom case fixture, making sure the back edge is away from you.
3. Engage the four sliding locks— *not* the two rollers.
4. Remove the battery cover.



5. Position the bottom case so that its front edge rests on the “shelf” of the lower two sliding locks.



6. Align the back of the bottom case to the vent/antenna module. The alignment is correct when you can feel that the long edge of the bottom case is flush with the smooth plane of the vent/antenna module.

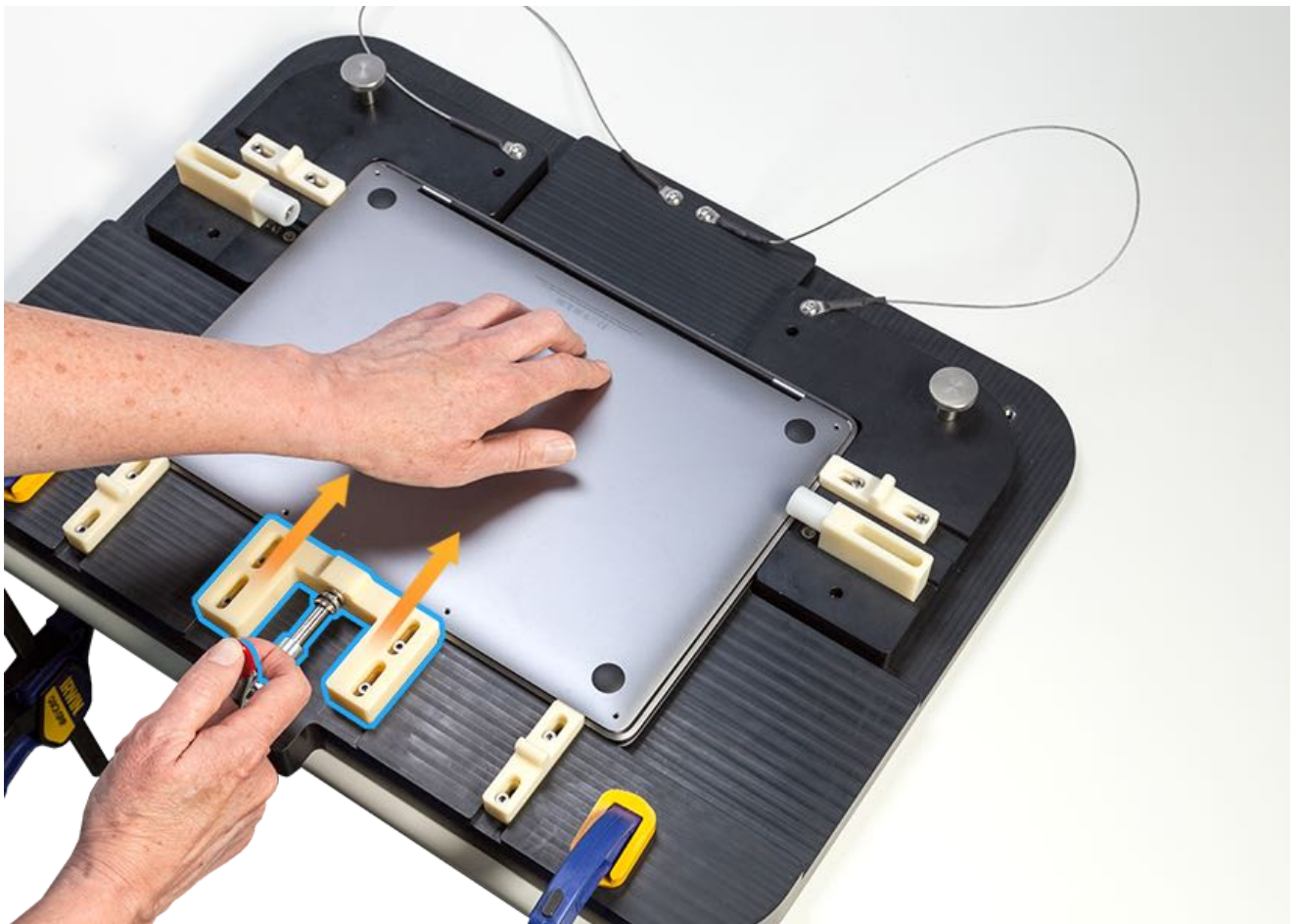


Important: When set up correctly, the notches at each rear corner show an equal gap. Likewise, if the bottom case were transparent, the two rows of spring fingers inside the bottom case would start to align with the metal tabs on the vent wall.



7. Hold light pressure near the back center edge of the bottom case while slowly engaging the red lever. Feel the spring fingers engage slightly as you press down on the bottom case.

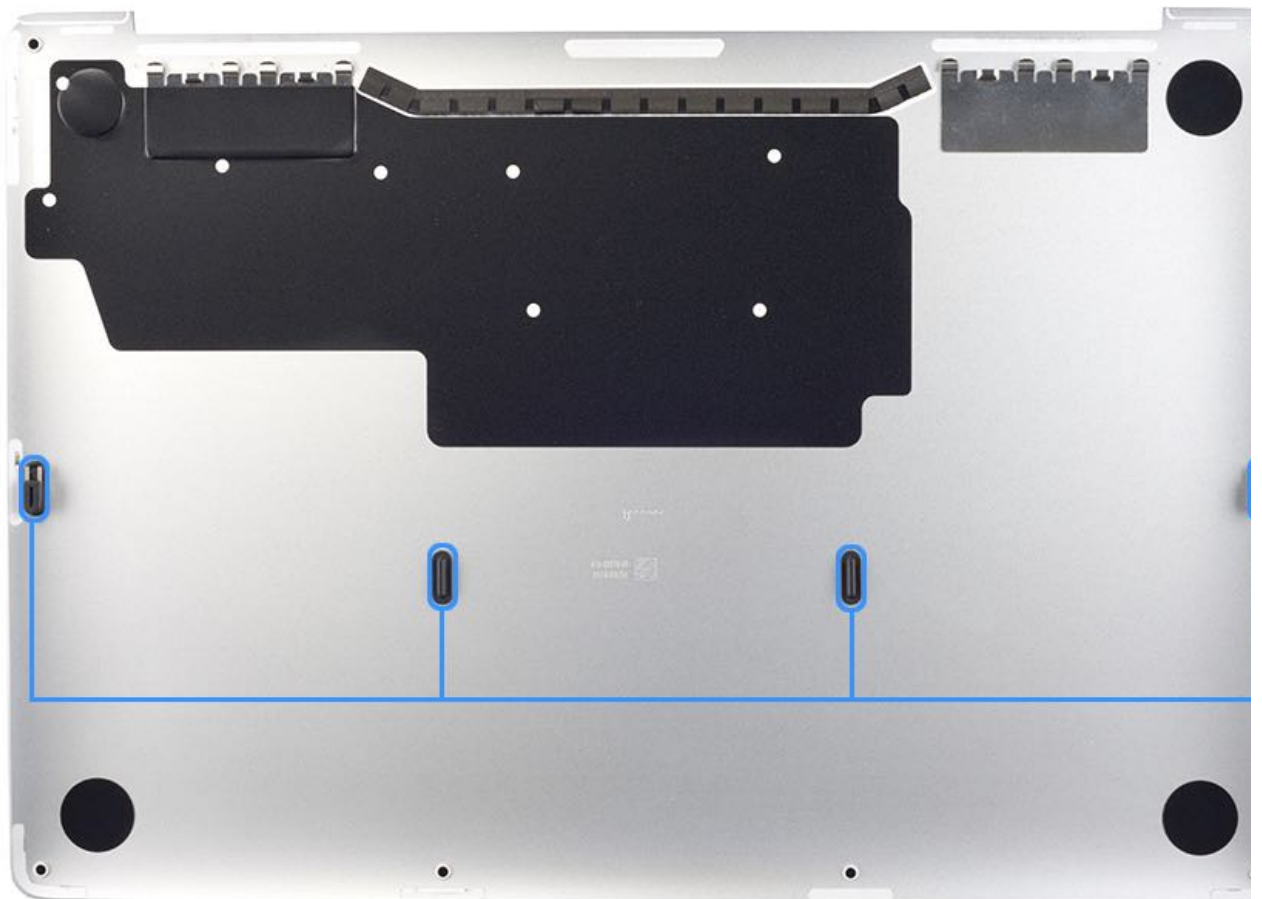
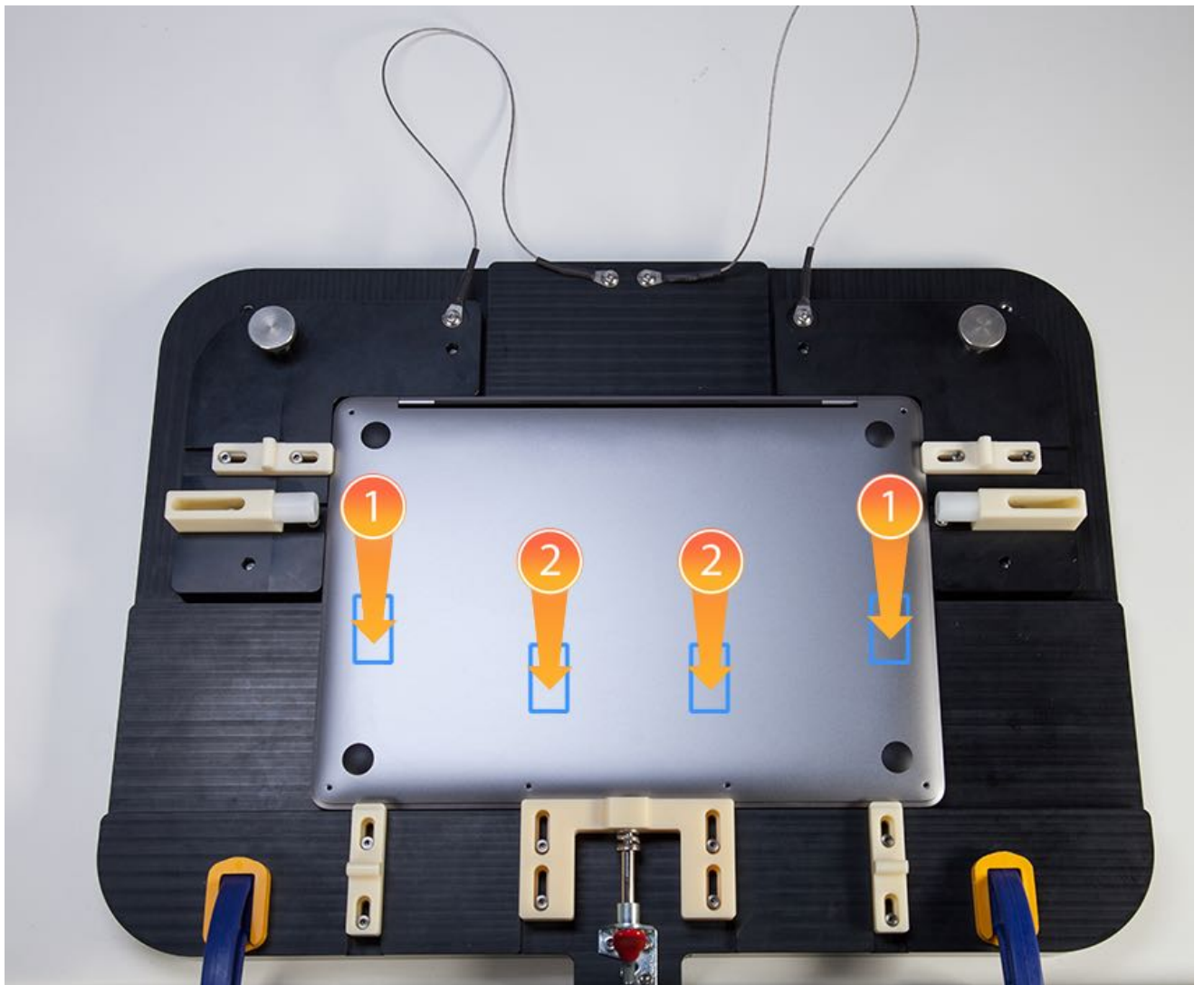
Caution: Pushing the red lever all the way can distort the bottom case and the lever spring.



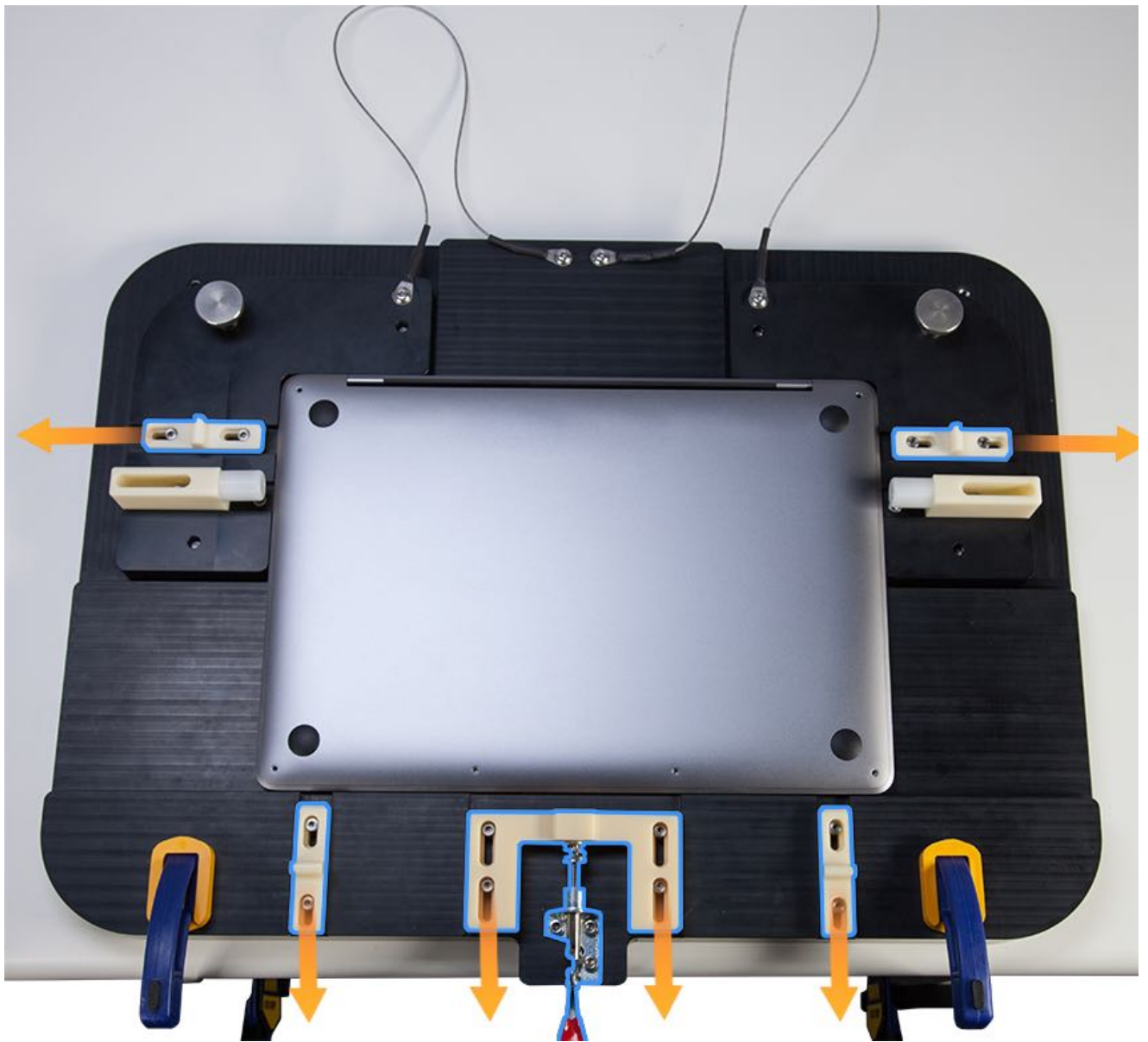
8. As soon as the rear corners of the bottom case meet the top case corners, disengage the lever.
9. If the bottom case is slightly misaligned, use the gripping texture of the gloves to gently apply pressure to adjust the case into alignment. If applying pressure does not realign the bottom case, remove the bottom case and try again.



10. **Important:** Press the sides (1) of the bottom case first to snap the two clips in the top case. Then press in the middle (2) of the bottom case for the two remaining clips.

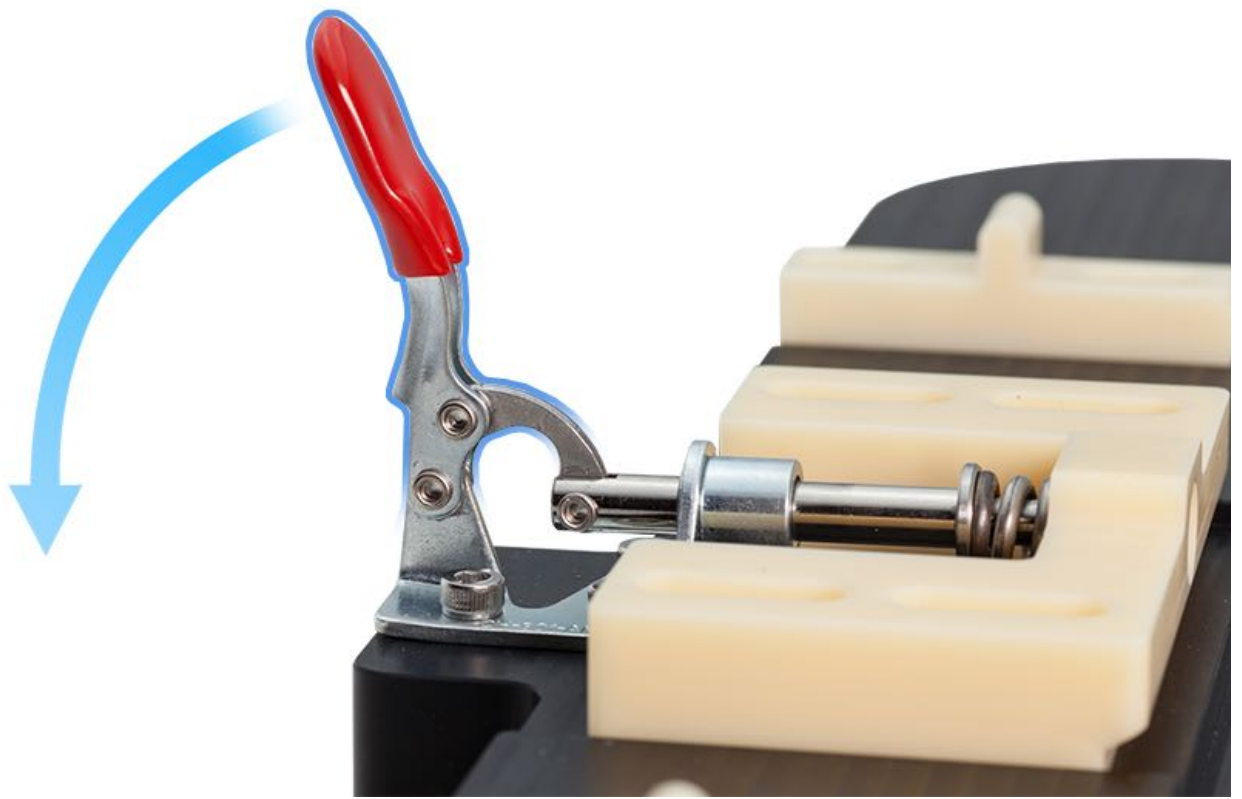


11. Fully disengage the four (4) sliding locks.



12. Remove the computer from the bottom case fixture.

Note: When storing the bottom case fixture, make sure that the red lever is not engaged. Keeping the red lever vertical or fully open protects its inner spring.



13. Check all sides of the bottom case for proper alignment with the top case.



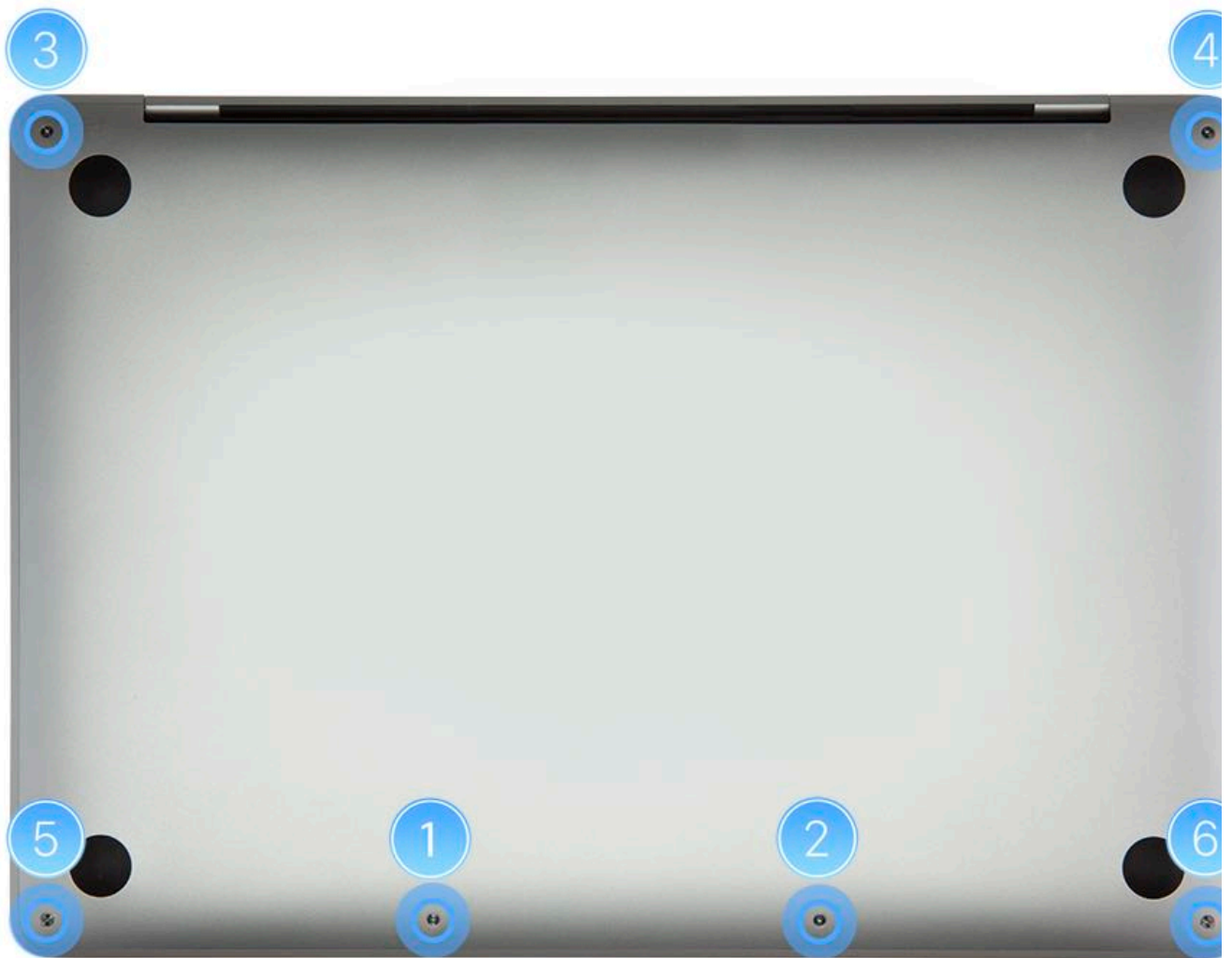
14. Install the six bottom case screws in the order shown:

1, 2 = short screws at middle front

3, 4 = longest screws at rear corners

5, 6 = medium length screws at front corners

Note: MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016 and 2017) only have two sizes of screws but reinstallation order is the same.



15. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
16. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Battery Cover and Disconnecting the Battery

First Steps



Warning:

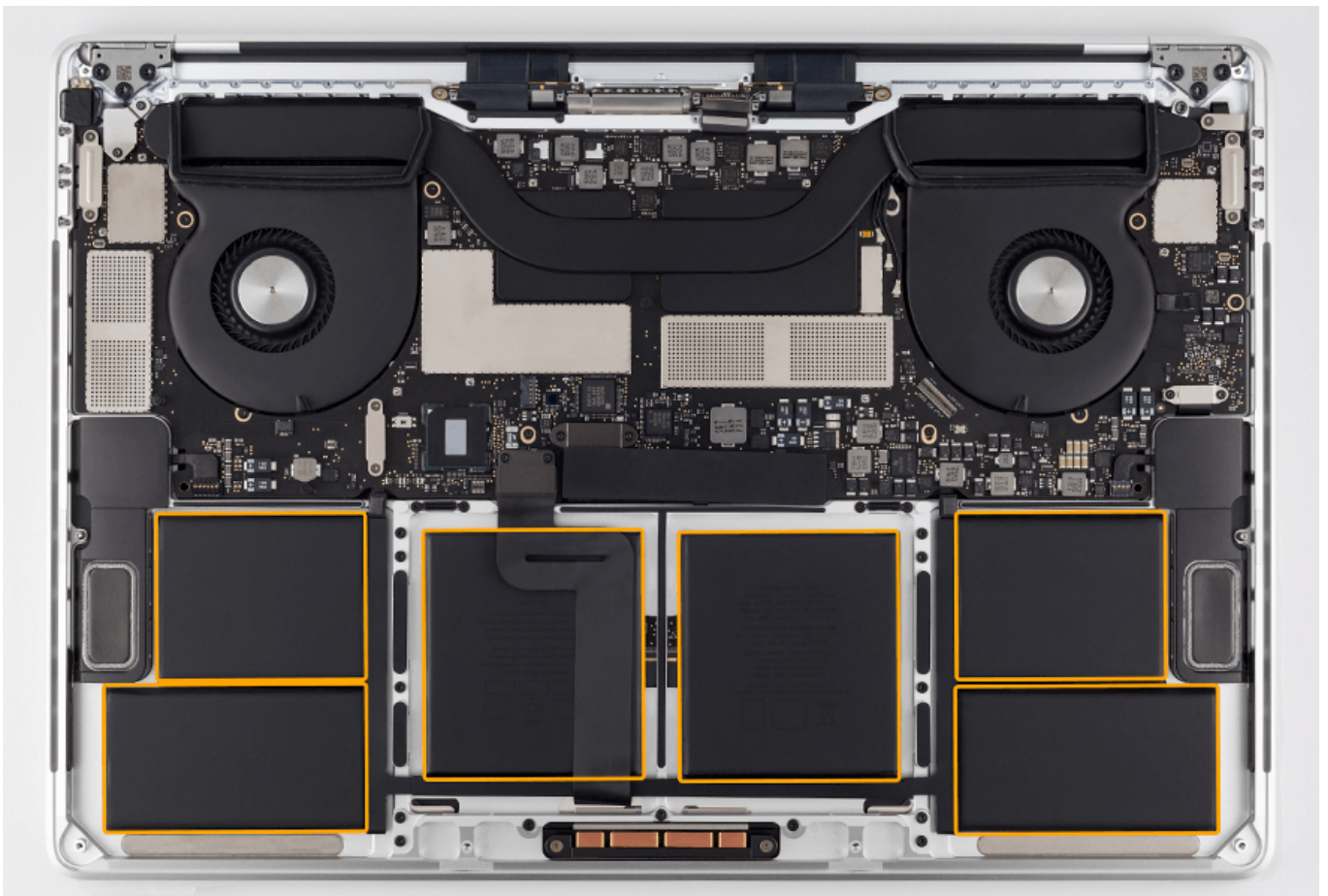
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)



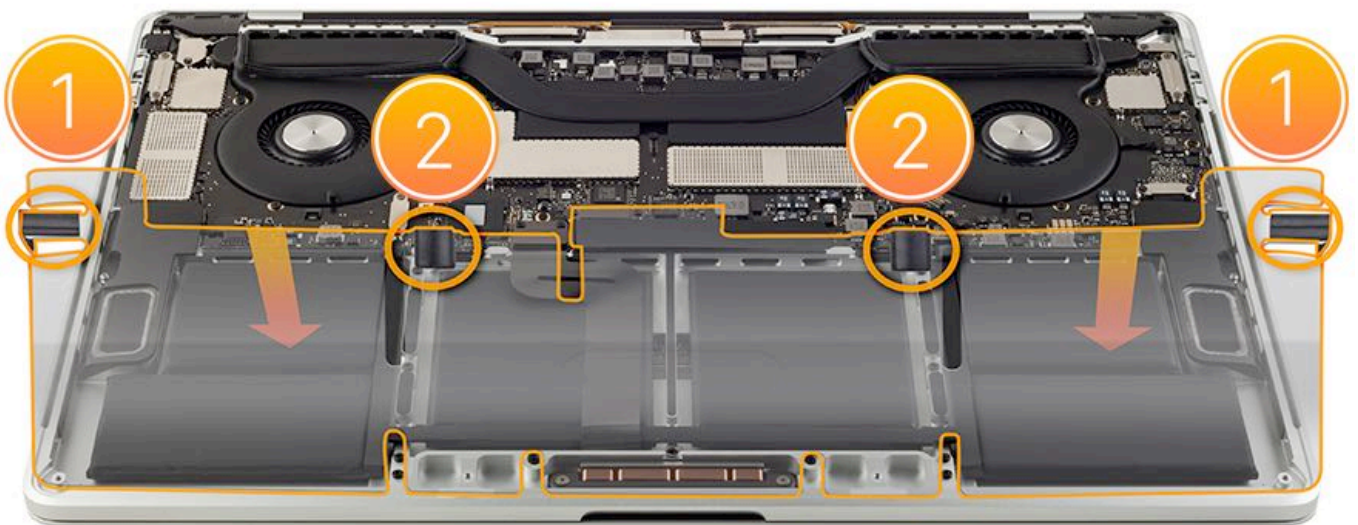
Tools

1. ESD-safe tweezers
2. Black stick
3. ESD wrist strap
4. Protective battery cover (923-01320)

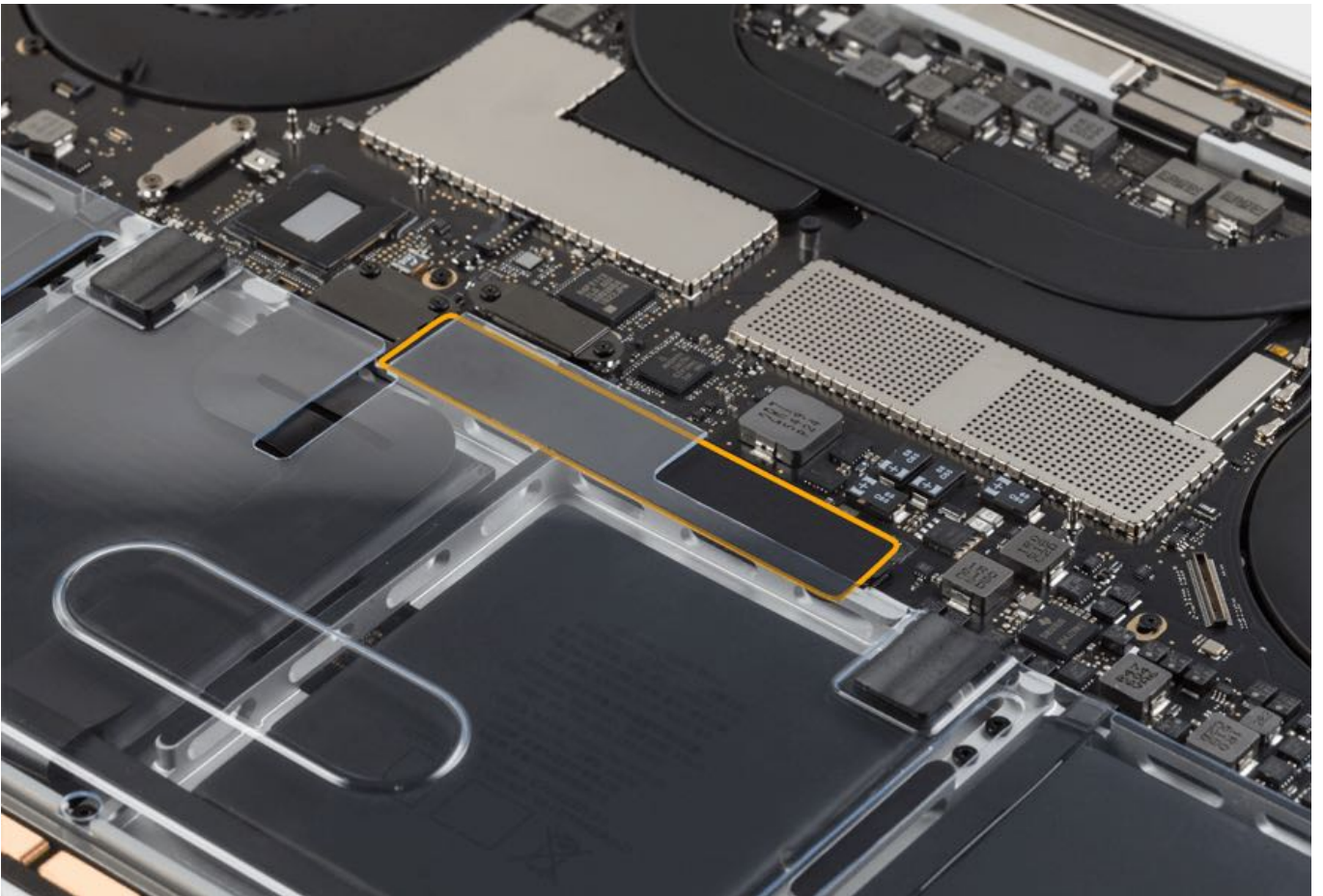


Steps For Removal

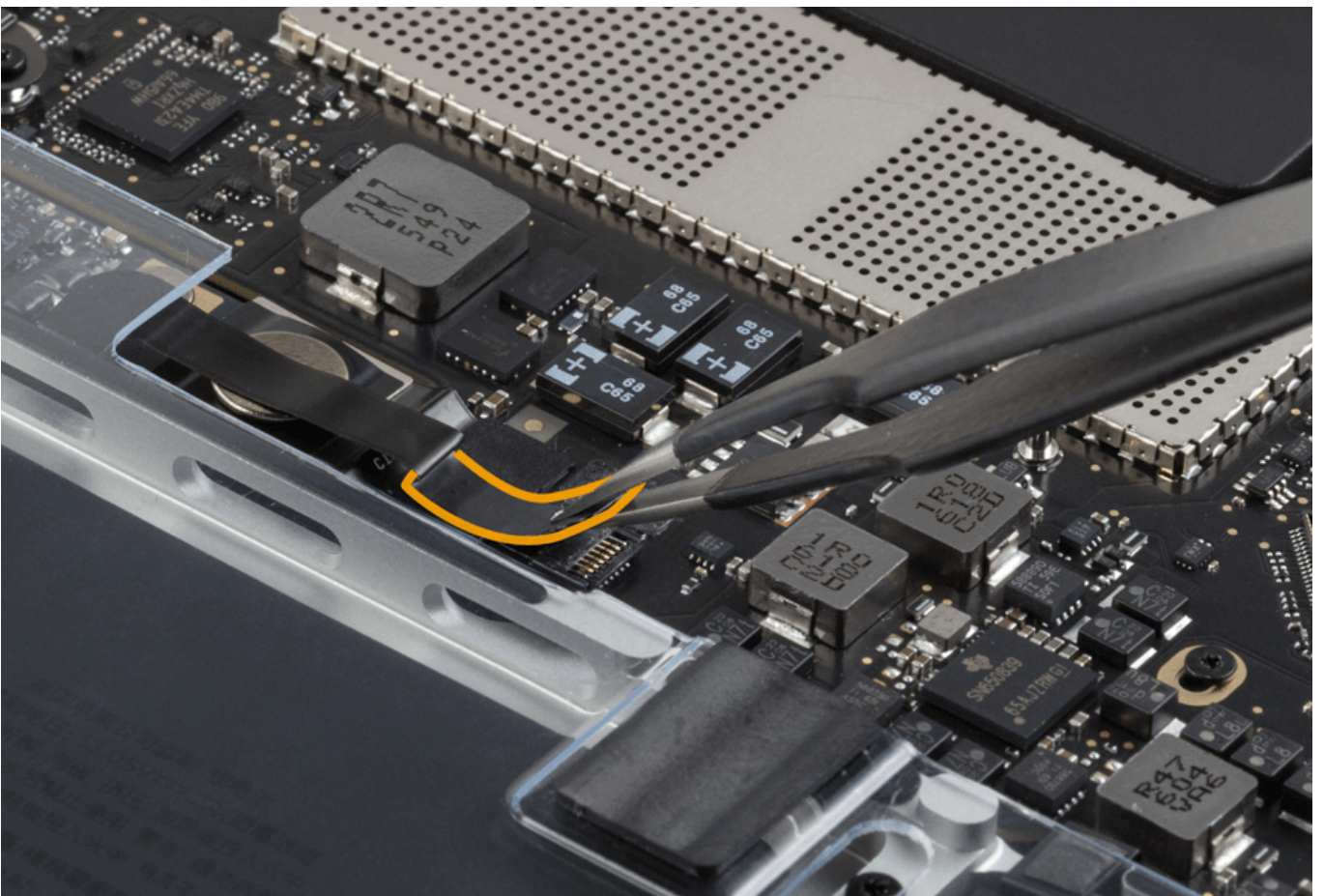
1. Tilt the bottom tabs of the battery cover into the slots at the bottom edge of the top case.
2. Carefully lower the cover onto the battery cells, making sure the tabs (1) on the sides of the cover fit into the notches on the edges of the top case.
3. Securely attach the battery cover with two clips that snap onto the midwall of the top case (2).



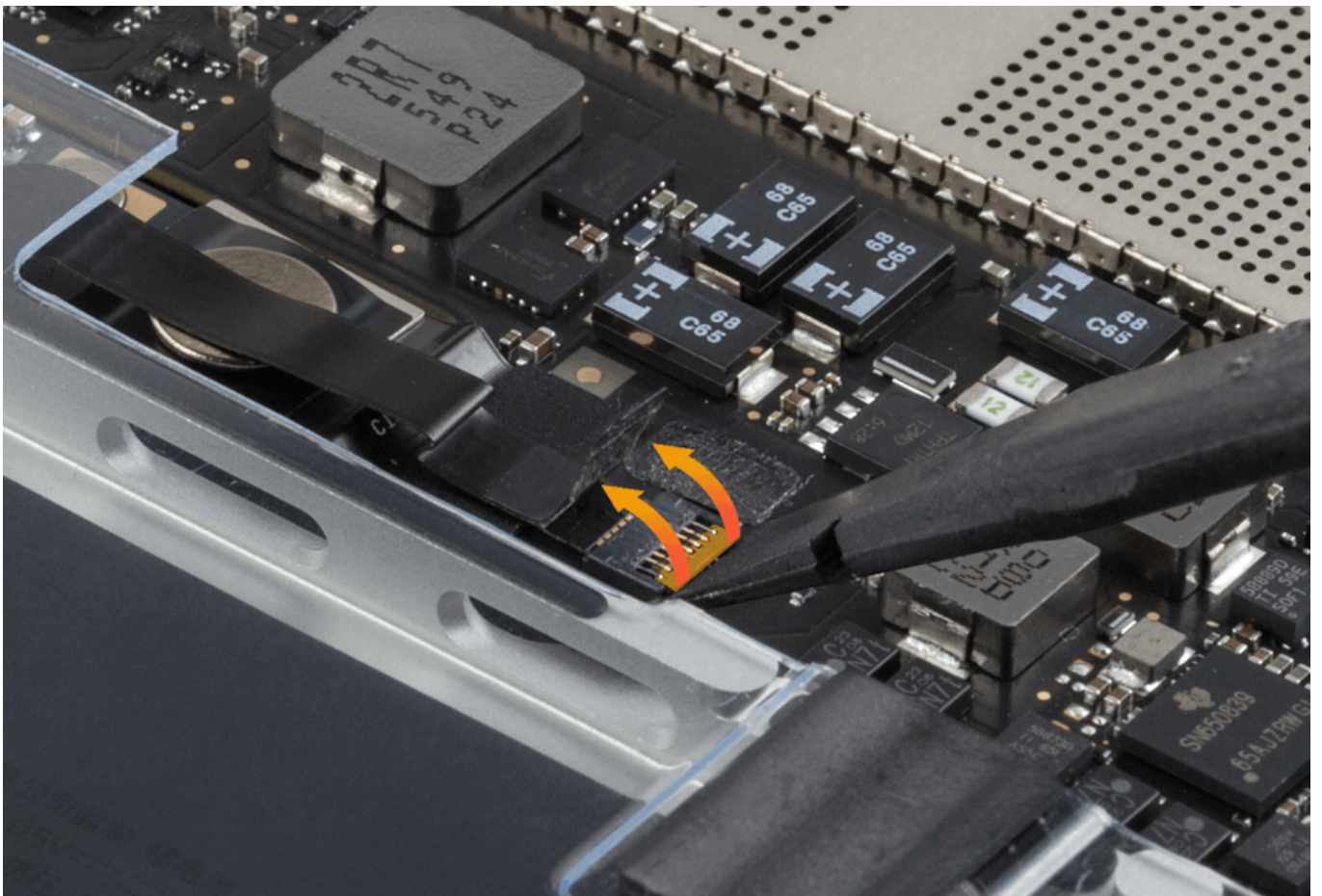
4. Remove the mylar BMU cover and set aside to be reinstalled.



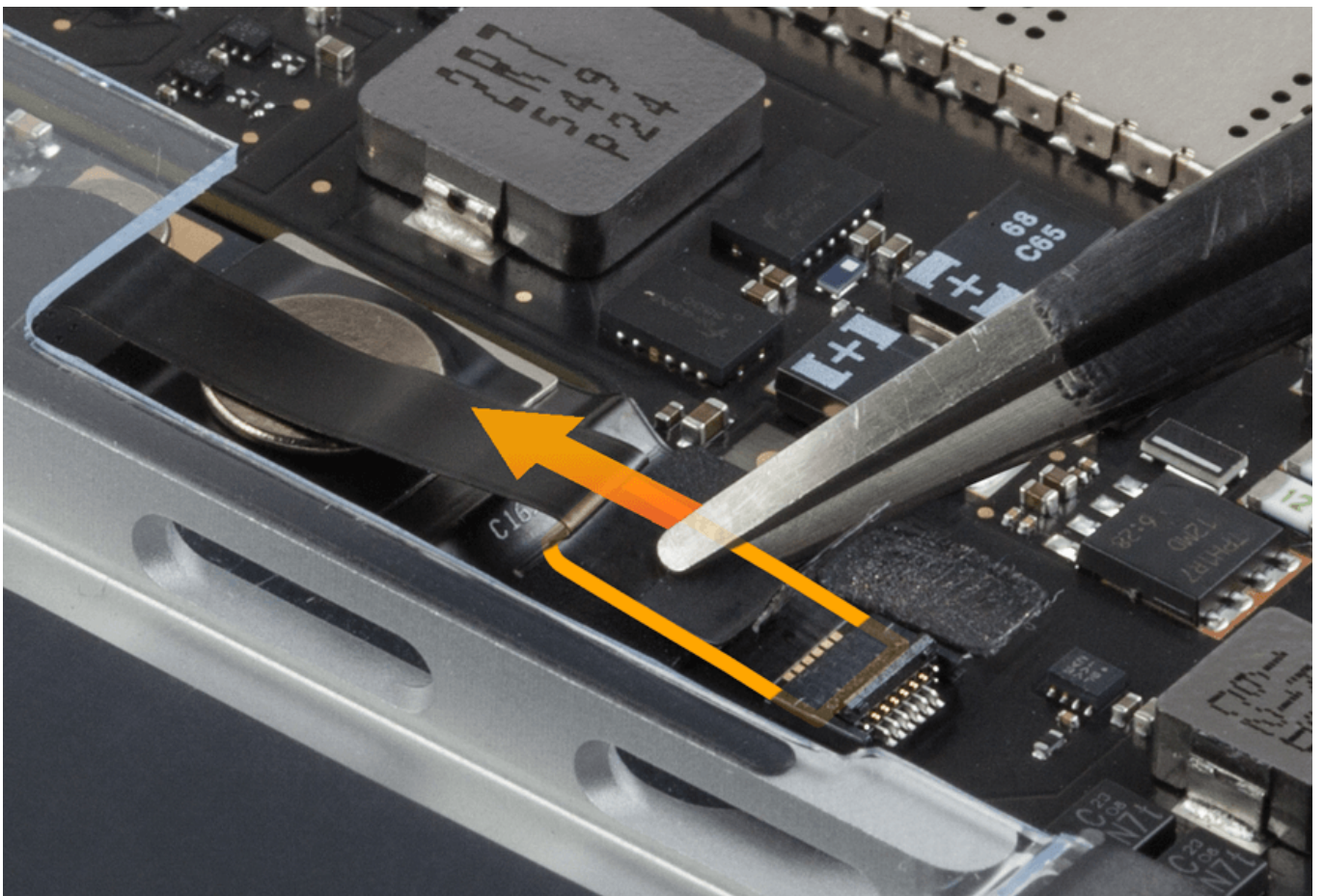
5. With tweezers, lightly grasp the mylar tab covering the battery flex cable connector and gently peel back the tab to expose the locking lever.



6. Use the flat end of a black stick to flip up the locking lever.



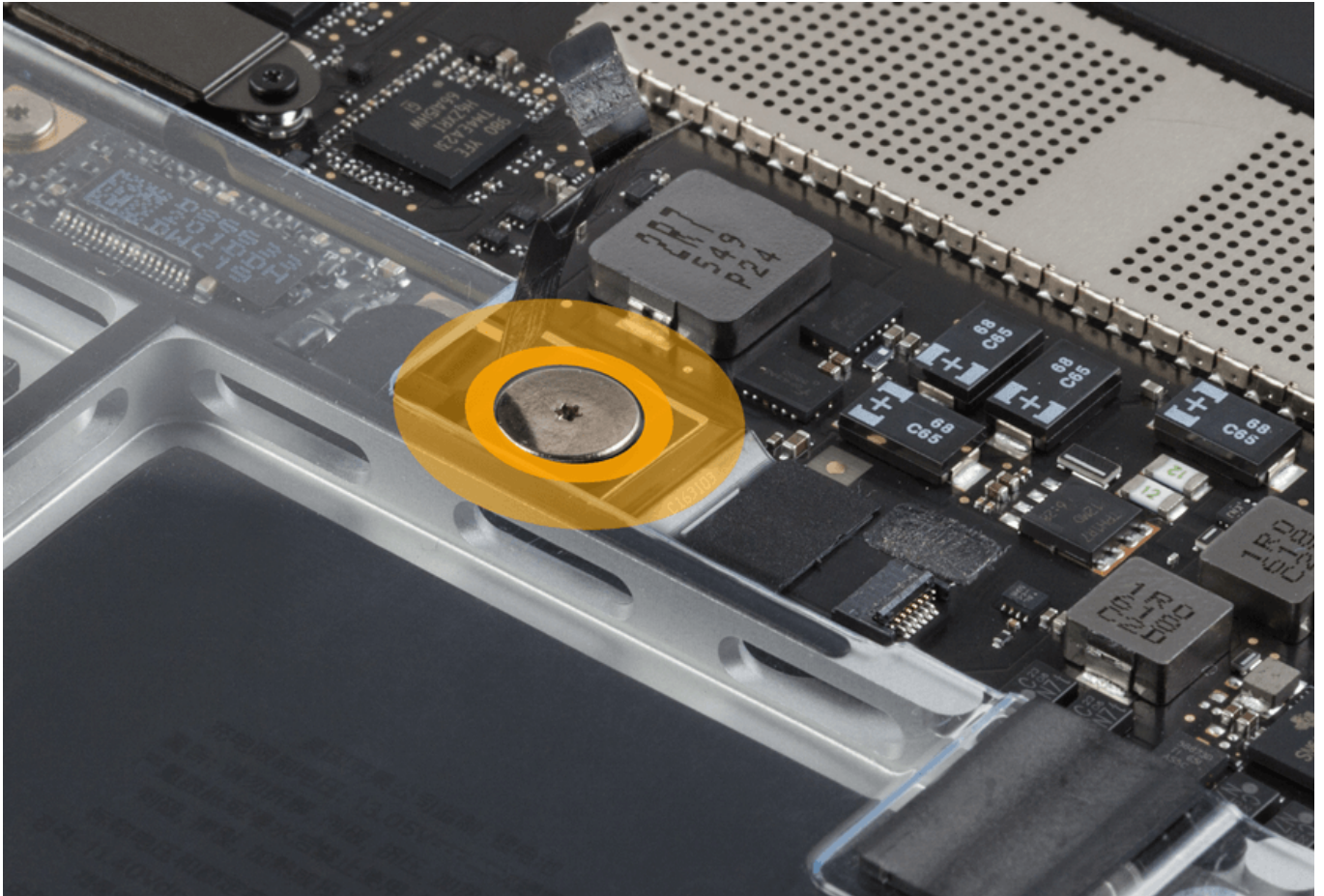
7. With flat-nosed tweezers, carefully remove the flex cable from the connector.



8. If removing or replacing the Logic Board, remove the Torx T5 BMU screw.



- T5: 923-01418



Steps For Reassembly

Reassemble in reverse order of removal steps.

Notes for reassembly:

- After reconnecting the battery flex cable, be sure to reinstall the BMU cover.
- Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
- Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Clutch Covers

First Steps



Warning:

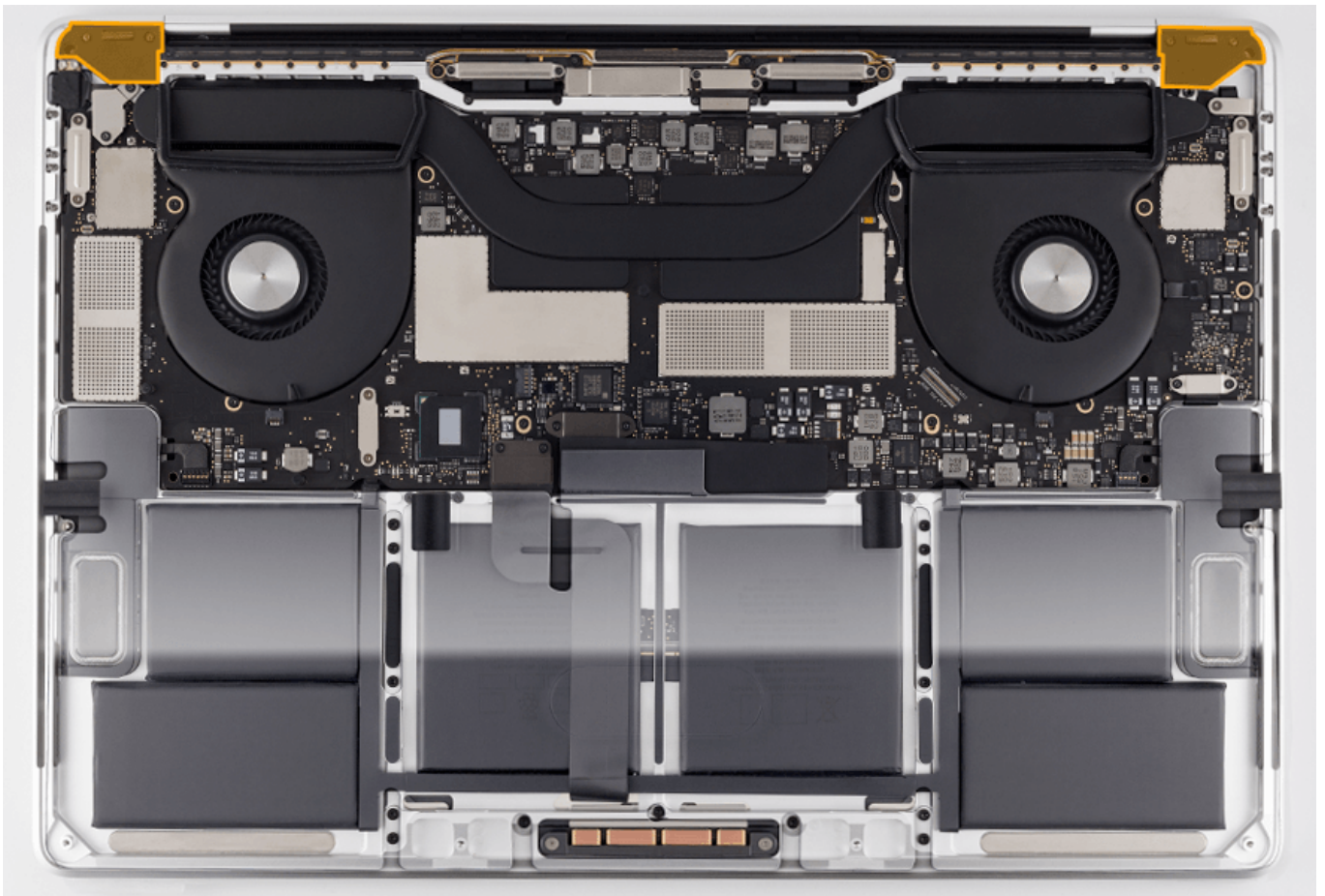
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)



Tools

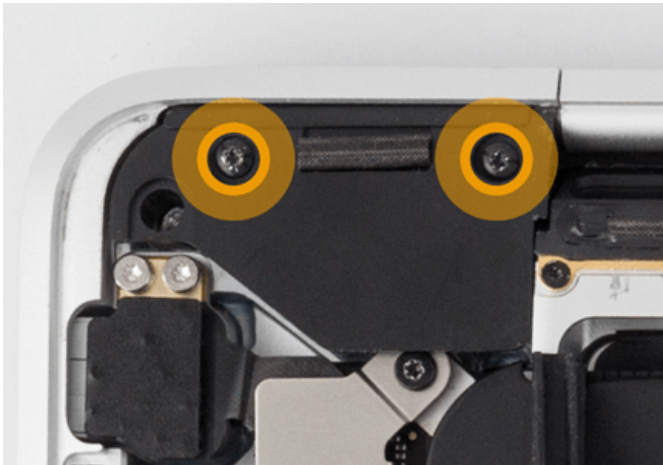
- Torx T3 driver
- Black stick
- ESD strap
- Protective battery cover (923-01320)



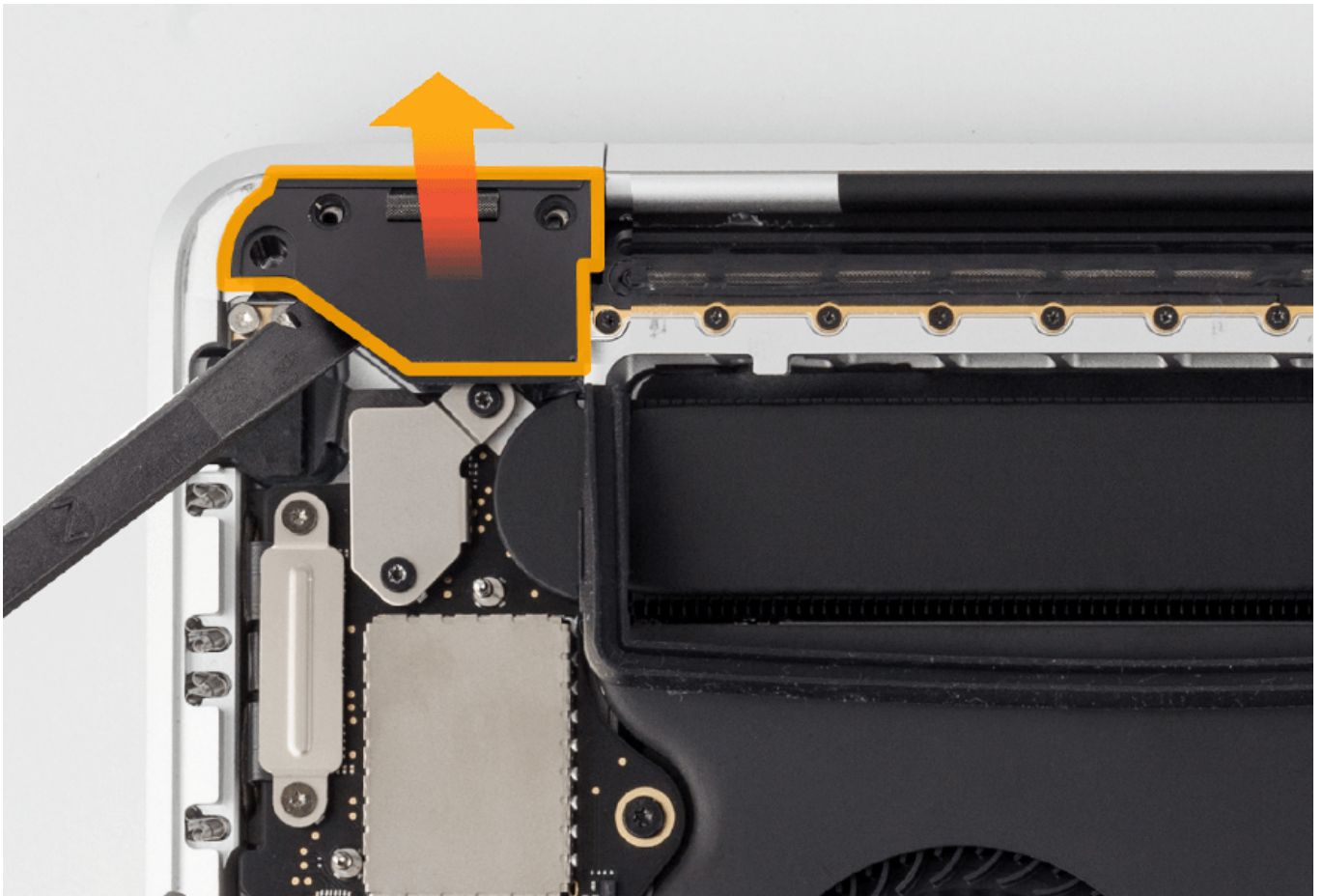
Steps For Removal

1. Remove two T3 screws from both the left and the right clutch covers.

- Two T3: 923-01286



2. Use a black stick to lift up each clutch cover and remove it from the top case.



Steps For Reassembly

1. Reassemble in reverse order of removal steps. **Note:** Reinstall each clutch cover so the top edge of the clutch cover seats under the top edge of the top case.
2. Reconnect the [battery](#) and remove the battery cover.
3. Reinstall the [bottom case](#).
4. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
5. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Logic Board

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

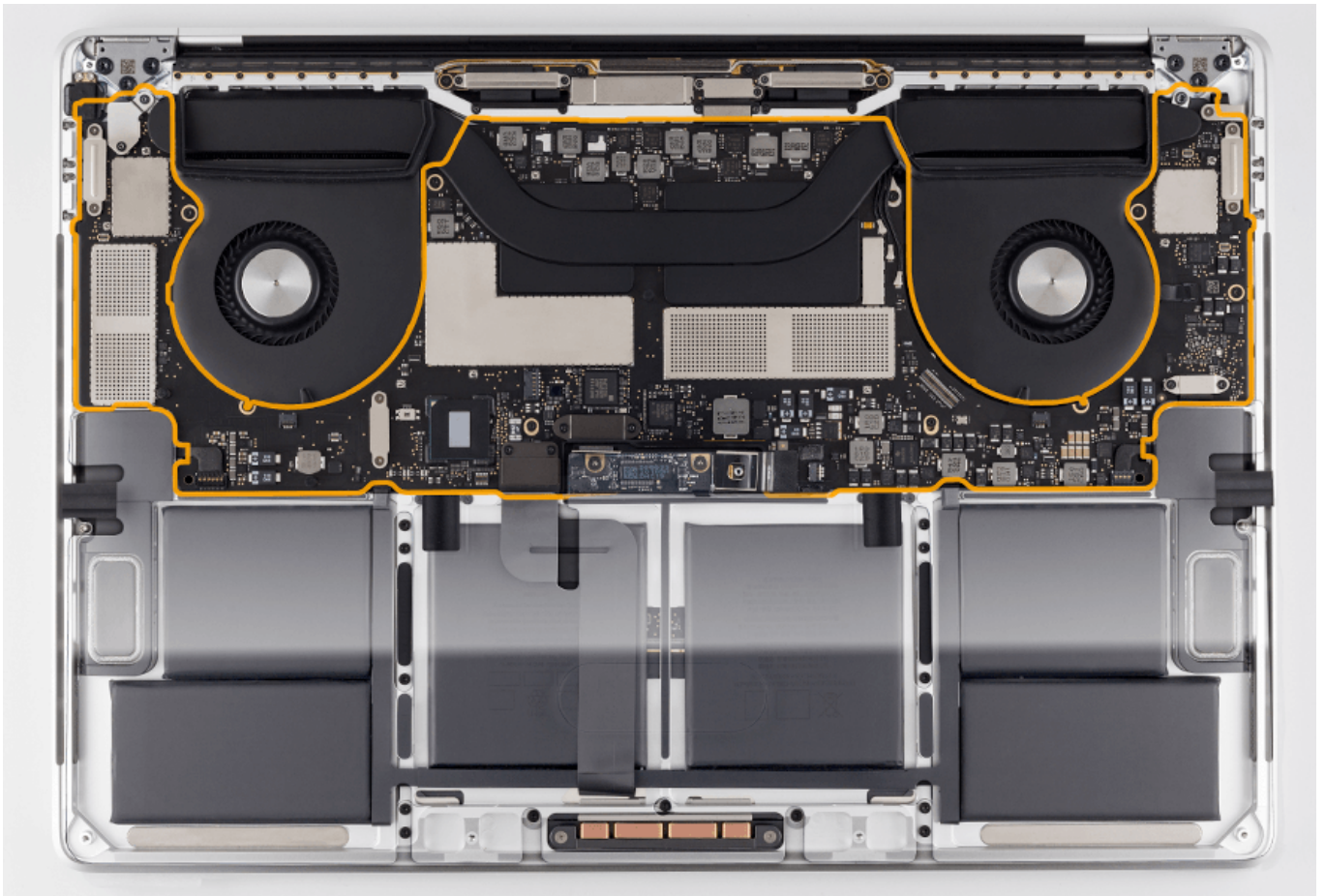
Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)

For video instruction, refer to article [SV331: Logic Board Replacement Video](#).



Tools

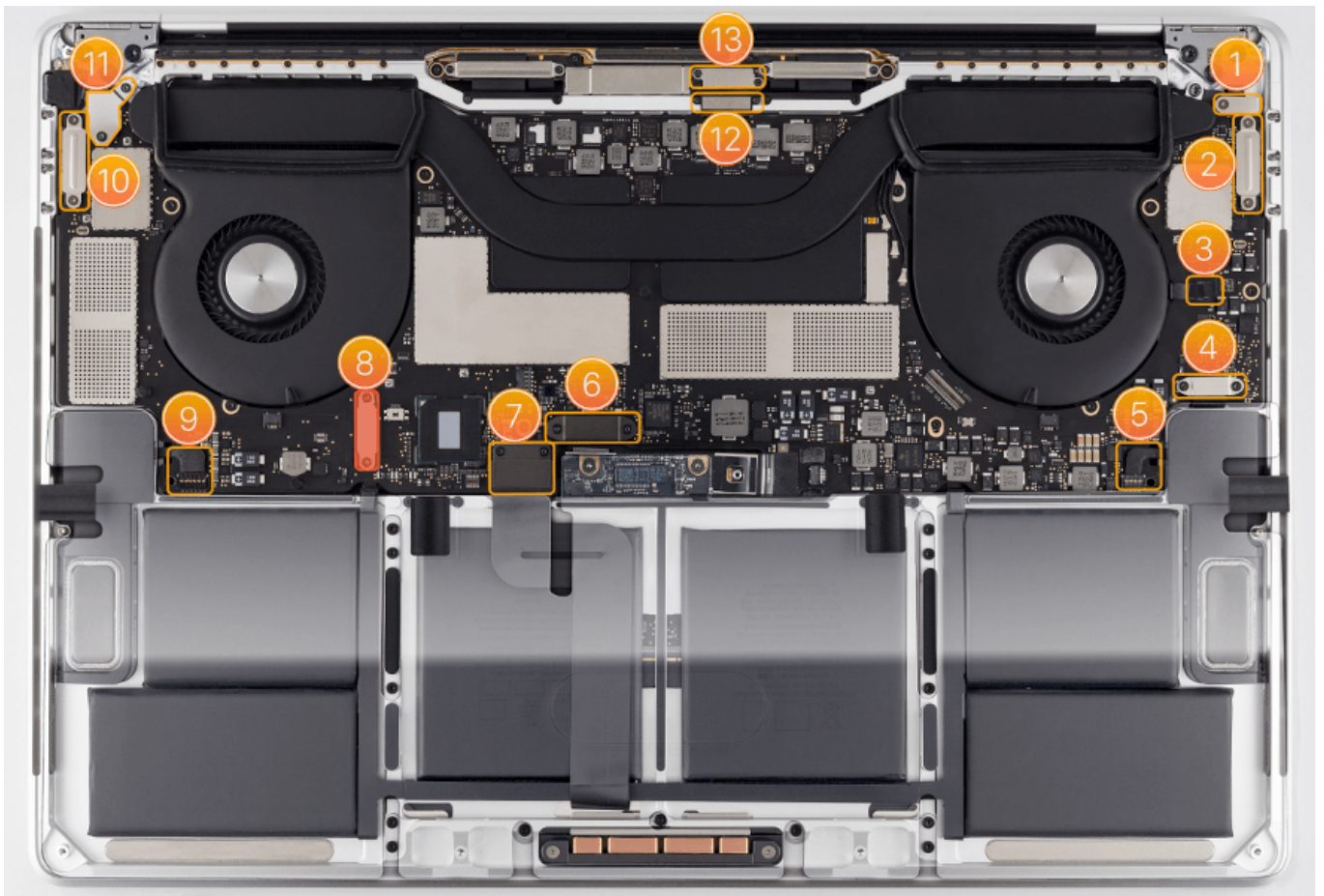
- Black stick
- Antenna removal tool
- Torx T3 driver
- Torx T5 driver
- ESD wrist strap
- Protective battery cover (923-01320)



Steps For Removal

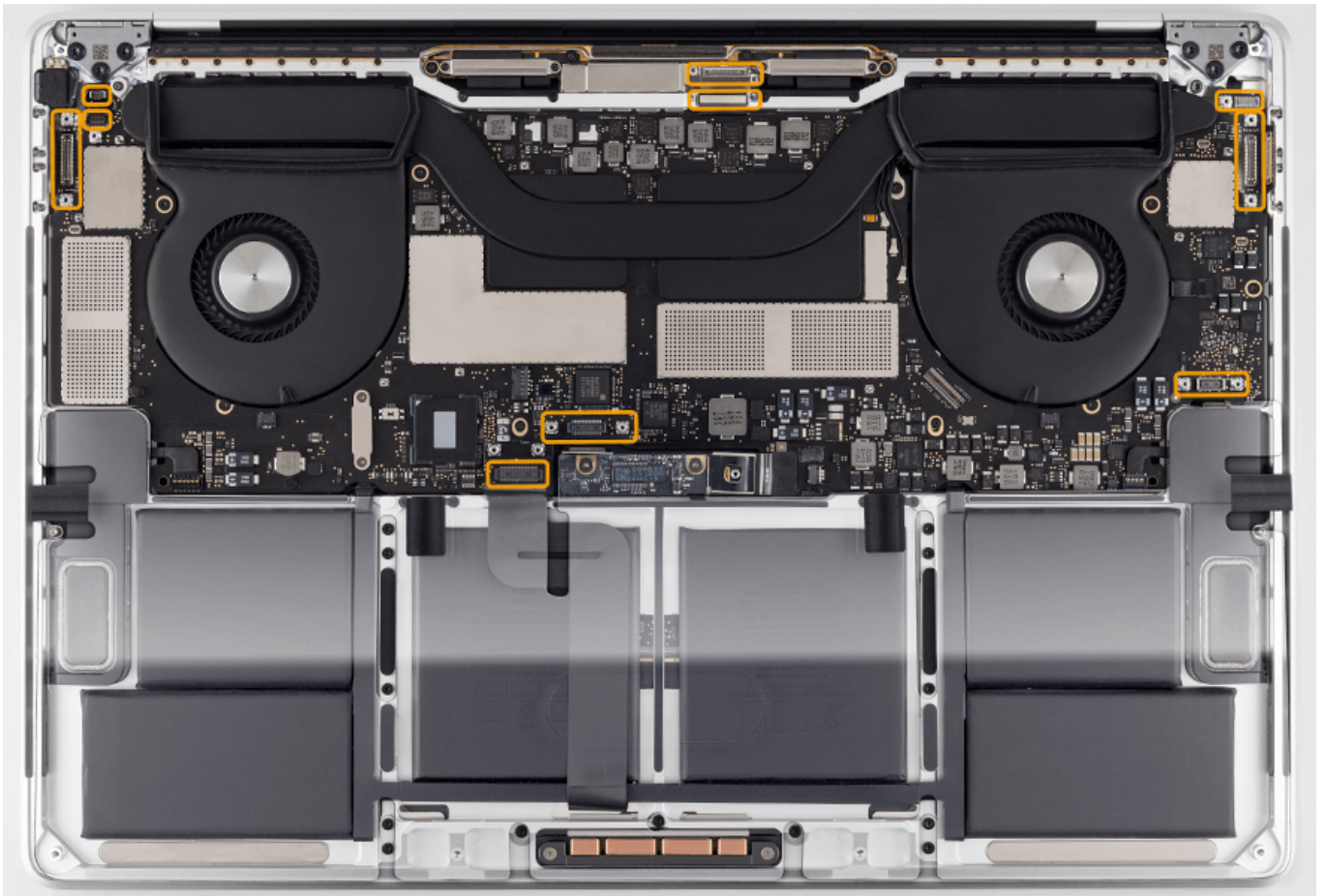
1. There are 13 connections to the logic board.

1. Touch Bar touch
2. Left I/O Board
3. Microphone
4. Touch Bar display
5. Left speaker
6. Keyboard flex cable
7. Trackpad flex cable
8. Customer Data Migration Tool connector (**Important:** Do not disconnect unless performing Data Migration.)
9. Right speaker
10. Right I/O Board
11. Touch ID Button and Audio Board
12. and 13. eDP flex cable

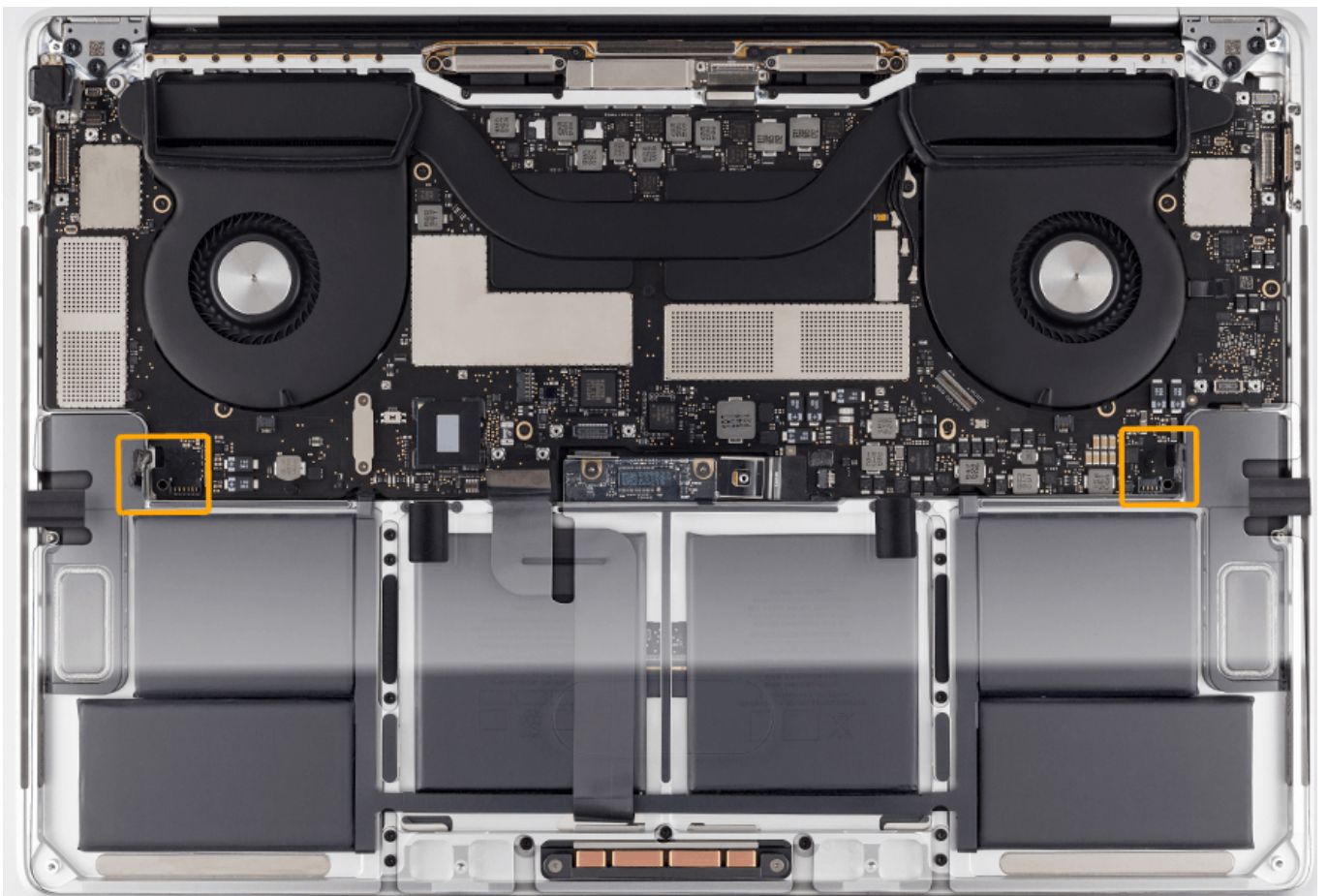


2. Remove the Torx T3 screws from the cowlings marked below, then disconnect the low-profile platform flex connectors with a black stick.

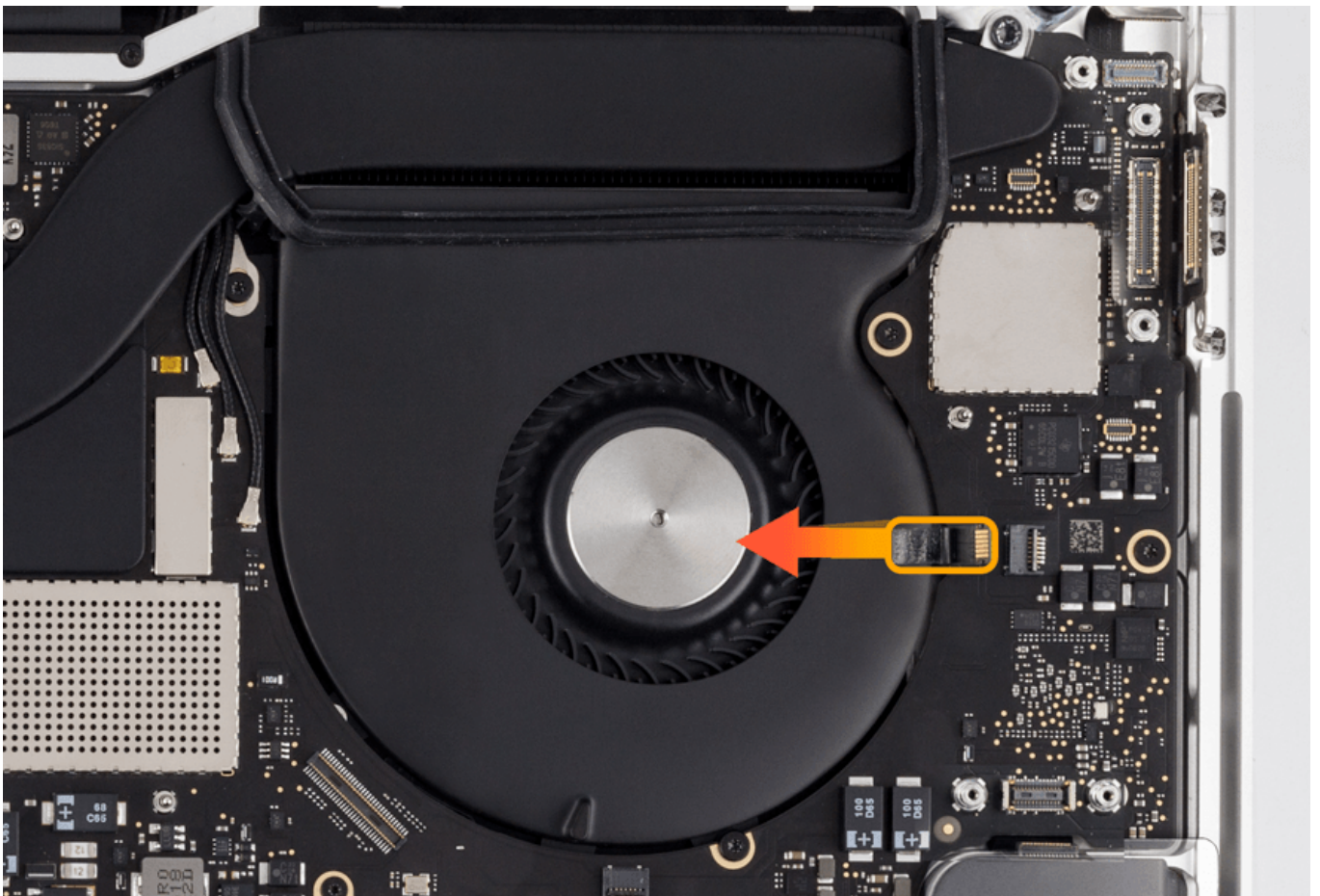
Note: The I/O boards (left and right) have attached cowlings.



3. Disconnect the two vertical insertion (JST) speaker flex cables. Note: The flex cables are adhered to the logic board with adhesive. Use a black stick to gently remove the flex from the board.



4. Disconnect one locking lever cable. Peel back the Mylar and use black stick to flip up the locking lever and disconnect flex cable.



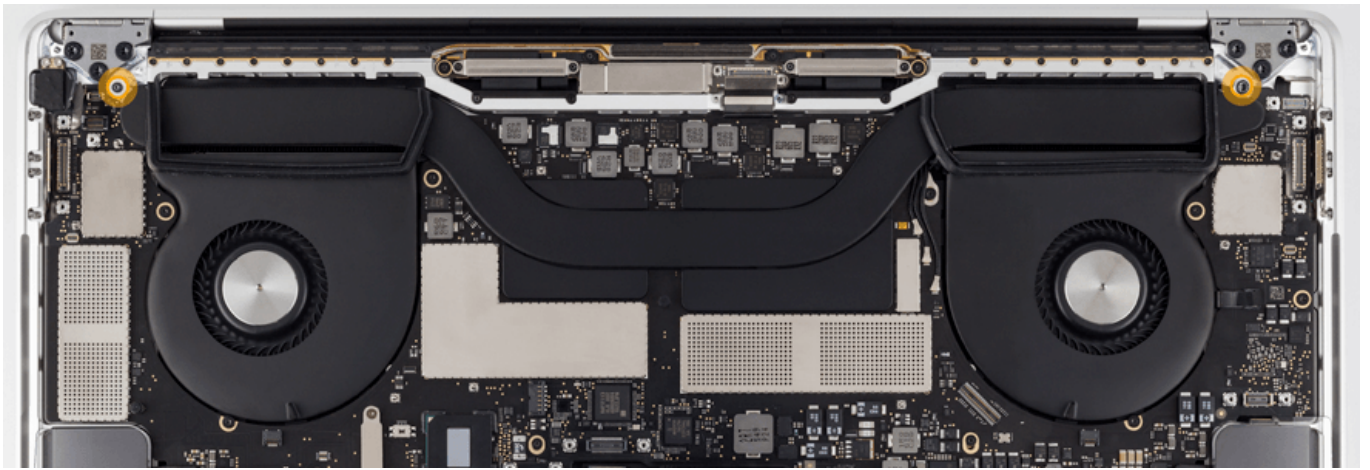
5. Remove two T8 screws from the heat sink.

- T8: 923-01505 (right)



- T8: 923-01502 (left) **Note:** The left screw is a screw within a screw.





6. Remove five T5 screws (1), one long T5 screw (2), and two T3 screws (3) from the logic board.

- T5 screws: 923-01500

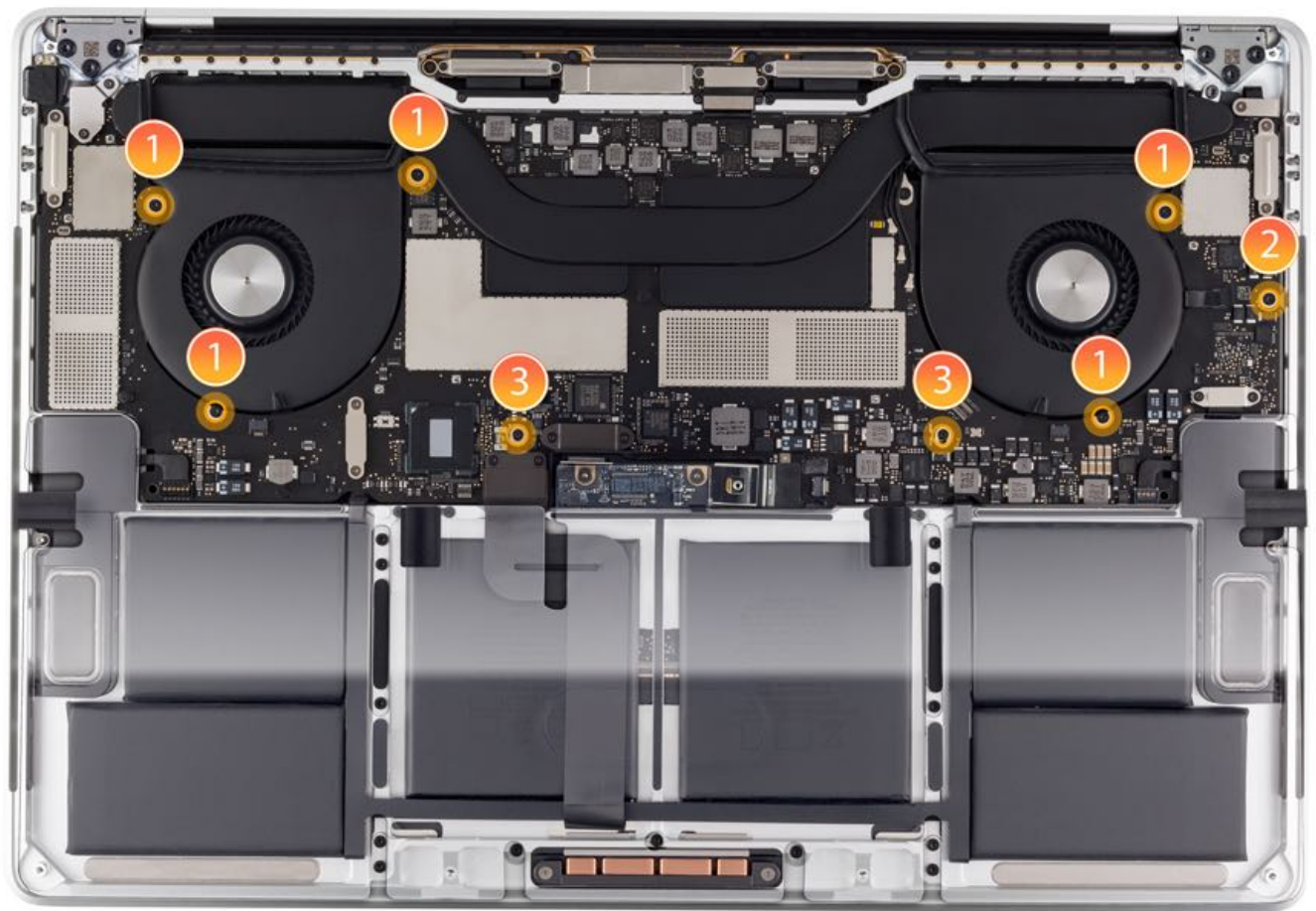


- T5 screw (long): 923-01498



- T3 screws: 923-01497





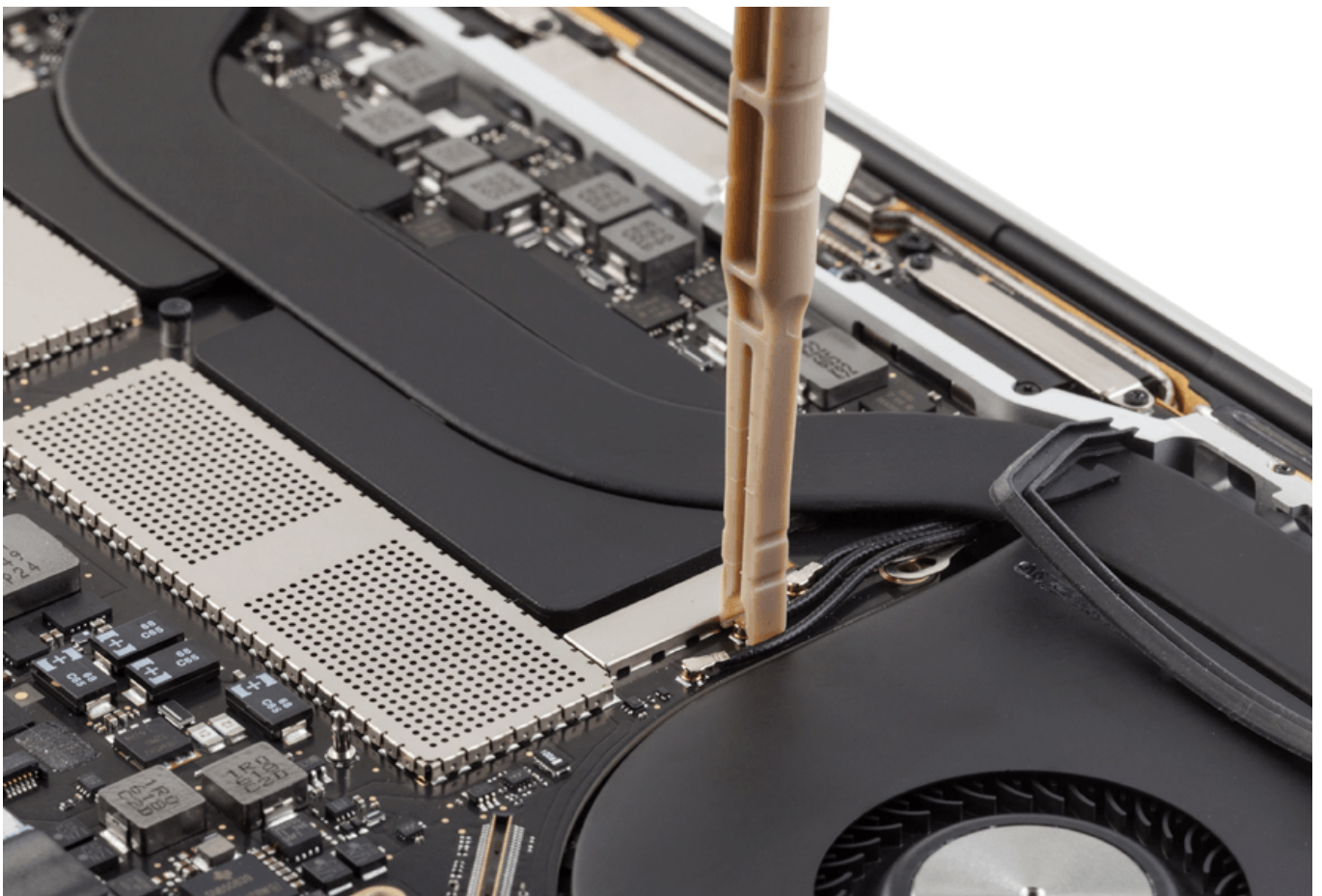
7. Remove the T5 antenna grounding screw.

- T5: 923-01500

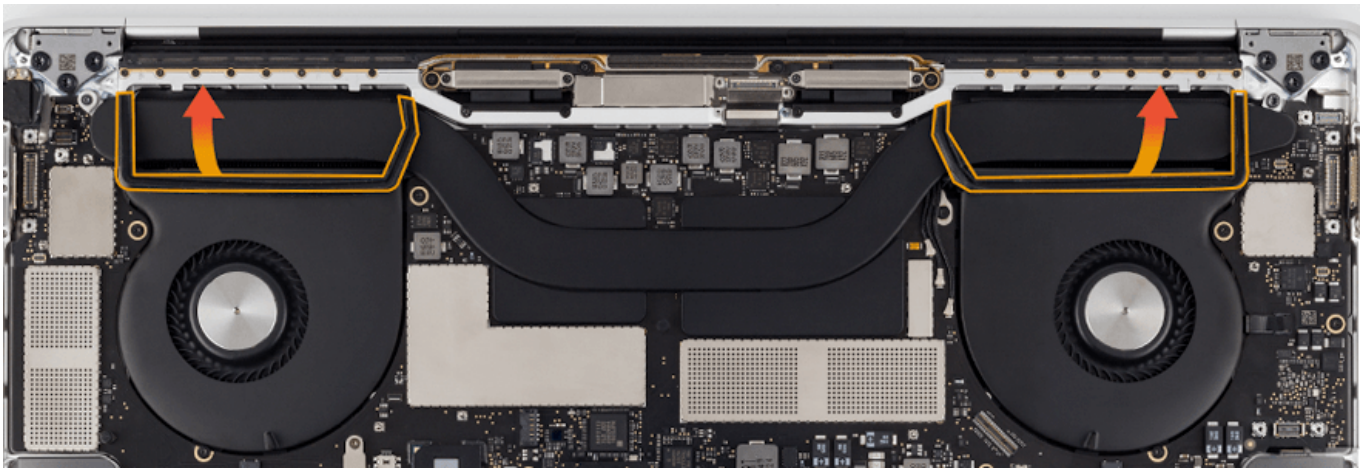




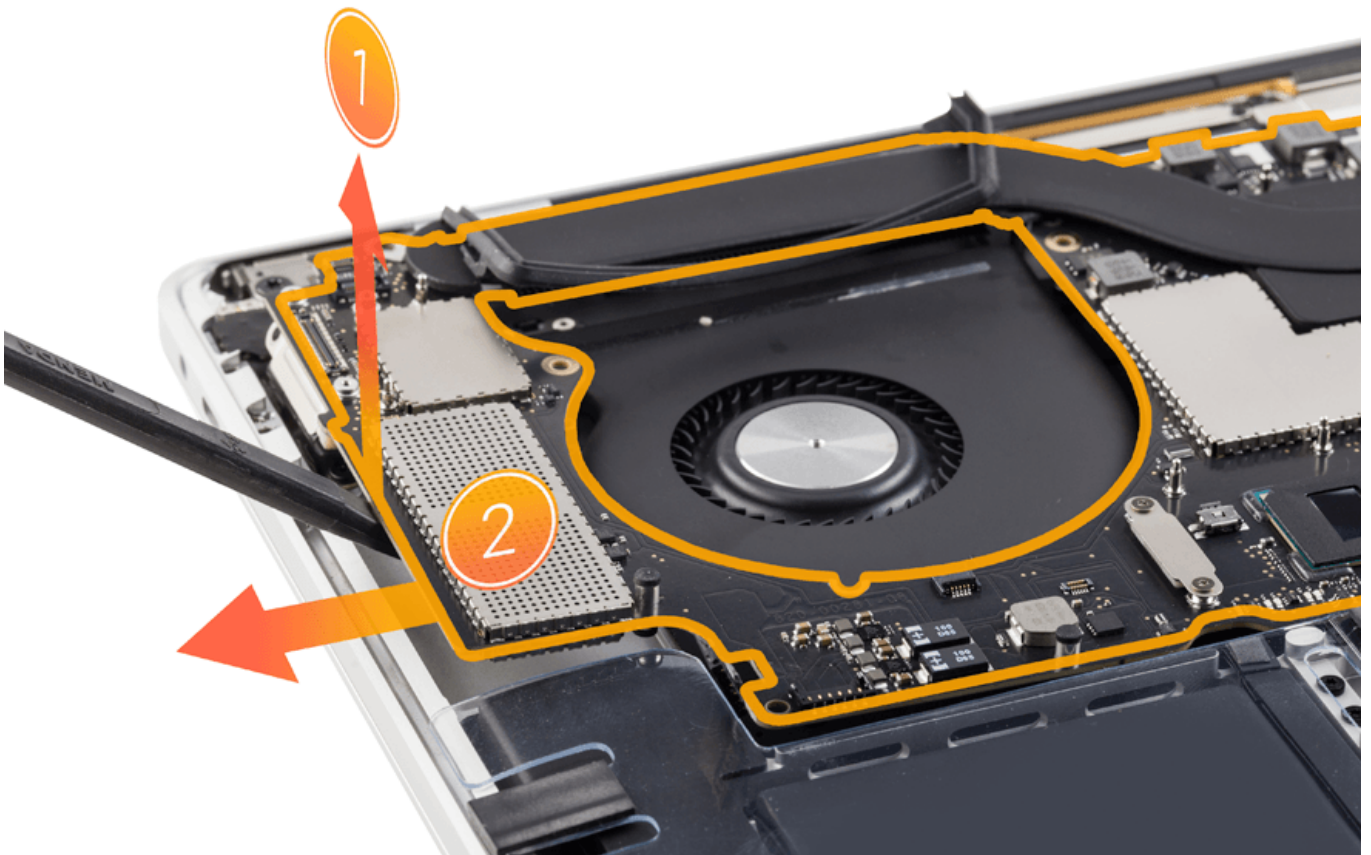
8. Using the antenna disconnect tool, disconnect the wireless and Bluetooth antennas.



9. Lift up, but not off, the thermal ducts from the fans.



10. Use a black stick to gently lift the board up and out from the top case.

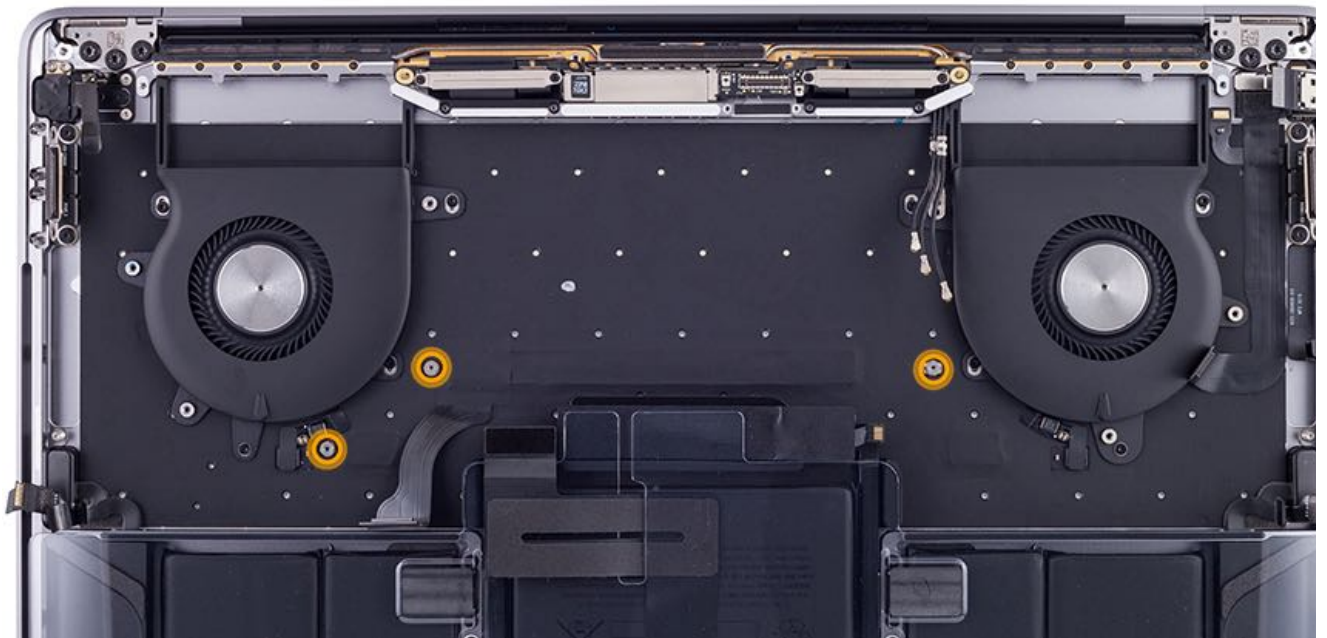


Steps For Reassembly

Reassemble in reverse order of removal steps.

Notes:

- Inspect the top case to make sure that the standoffs that surround the fans are present. If they are not, order replacement standoffs (923-01436.)

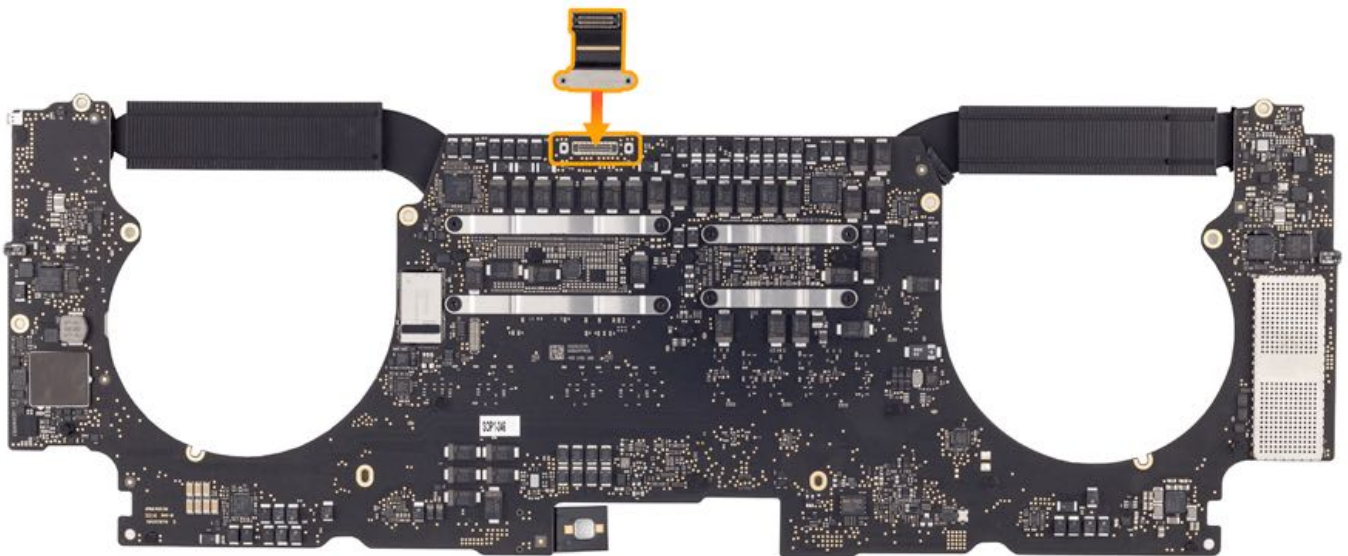


- Be sure no cables are caught under the logic board before attaching the antennas and screwing down the logic board. Bending the cables under the board can cause damage to the cables.

Important: If the logic board is replaced, the Touch ID must also be replaced. See [RP1301: Touch ID Board](#).

1. If you are installing a replacement logic board, remove and transfer these parts to the replacement board:

- [Heat sink](#)
- [eDP flex cable](#)



2. **Note:** There is a hook on the Touch Bar Touch connector that needs to be fastened when reinstalling the Touch Bar Touch cowling. It is helpful to use tweezers.



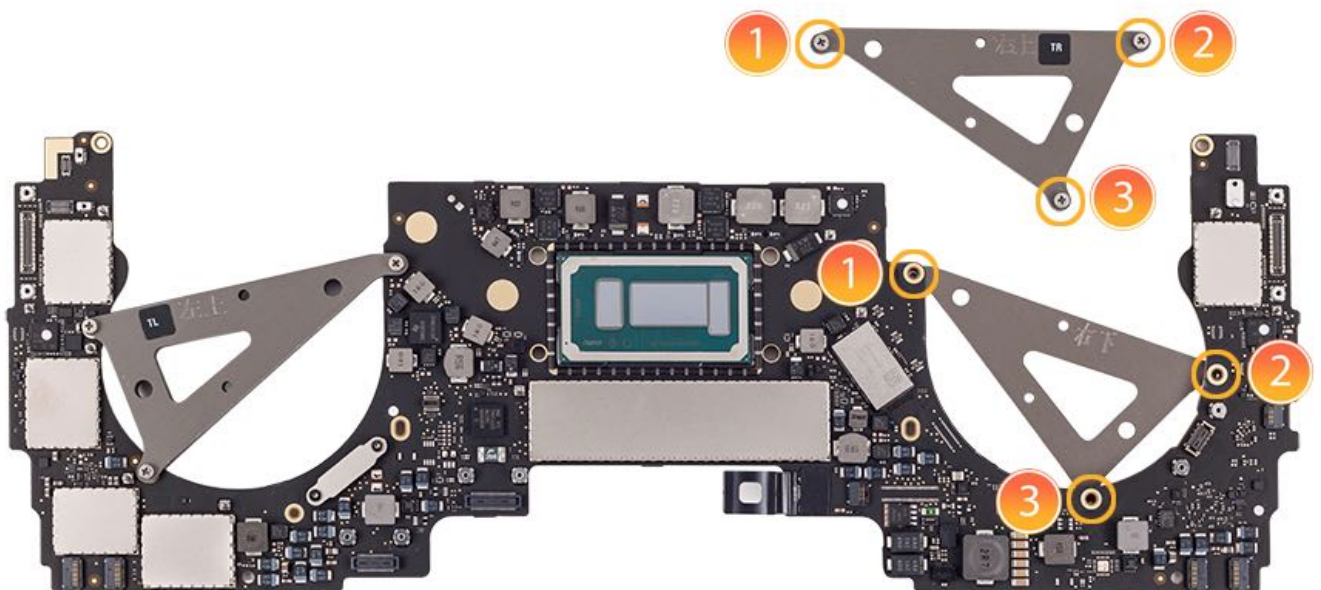
3. When reconnecting the antennas, use tweezers to align the antenna head with the connector on the logic board. Then use the flip side of the antenna removal tool to make the connection.





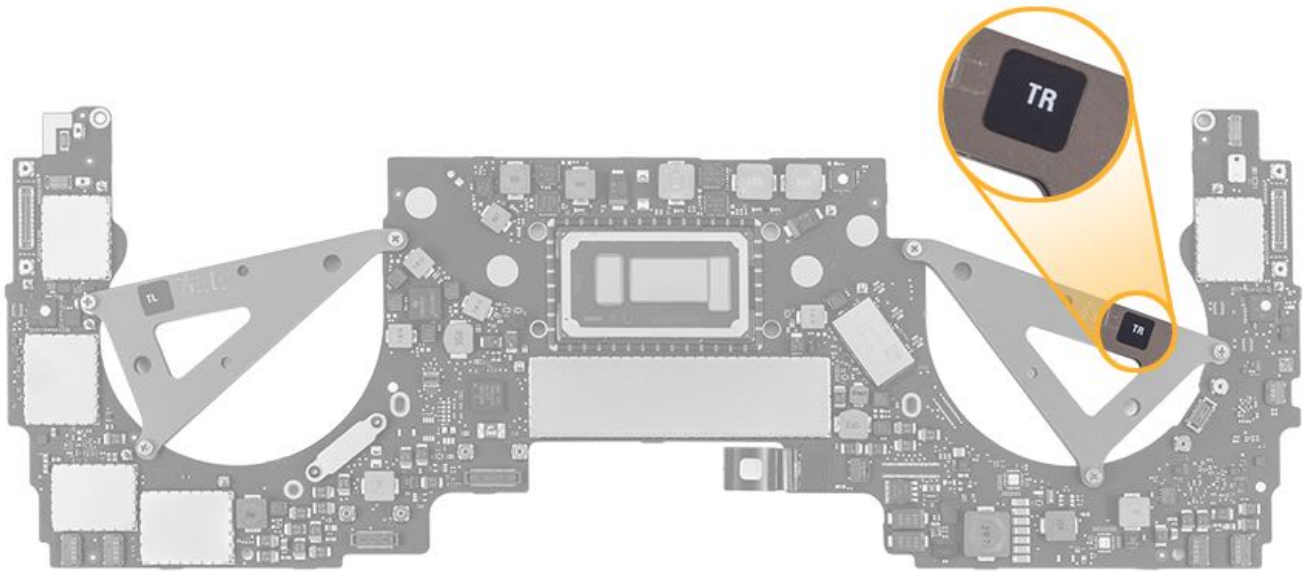
4. Transfer the two triangular stiffeners from the replacement logic board to the known-bad board. **Caution:** The triangular stiffeners must be placed in the KBB logic board before returning to Apple Service or the logic board may be damaged during shipping.

- Loosen the three Phillips #00 captive screws from the top of the stiffener.
- Separate the two halves of the stiffener and align them onto the known-bad board.
- Tighten the screws and repeat these steps for the other triangular stiffener.
- Place the known-bad board in the logic board holder (923-01130) and return it to Apple service.



Note: The stiffeners have labels for position identification.

- TL-Top Left
- TR-Top Right
- BL-Bottom Left
- BR-Bottom Right



5. Reinstall the [clutch covers](#).
6. Reconnect the [battery](#) and remove the battery cover.
7. Reinstall the [bottom case](#).
8. Perform diagnostics.
 - If the logic board has been replaced with a new board, perform the Top Case to Logic Board Configuration Suite in AST 2. This suite includes the Trackpad Calibration Check.
 - If the old logic board has been reinstalled, verify the trackpad performance with the Trackpad Calibration Check.
 - For instructions on trackpad calibration, refer to article [TP1314: Trackpad Calibration Check](#).
9. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Reinstalling Software That Came with the Computer

Reinstalling Software That Came with the Computer

This procedure requires an Internet connection.

Note: In some situations, a user may have set a firmware password via a feature such as Find My Mac or FileVault. The user must know the firmware password in order to reinstall OS X or macOS. If the user cannot remember the password, then refer to the technician instructions in article [HT203409: If you lost or forgot your firmware password](#).

Important: Apple recommends that users back up their data before any software restore procedure. Back up essential files before installing OS X or macOS. Apple is not responsible for any loss of data.

1. Choose Apple menu > Restart, then hold down the Command (⌘) and R keys while the computer restarts.
Note: To force OS X Lion or later, or macOS Sierra, into Internet Recovery, press and hold the Command-Option-R key combination while starting up the computer.
2. If the computer is not connected to the Internet, choose a network from the Wi-Fi menu (in the top-right corner of the screen).
3. Select "Reinstall OS X" (or macOS), then click Continue.
4. Follow the onscreen instructions. In the pane where you select a disk, select your current OS X or macOS disk (in most cases, it is the only one available).
5. To start the installation, click Install.

Check for and apply the latest software and firmware updates.

For more information, refer to article [HT201314: About macOS Recovery](#).

Using the Customer Data Migration (CDM) Tool

Using the Customer Data Migration Tool for MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016 and 2017)

The Customer Data Migration (CDM) Tool can be used to migrate user data when the logic board on the user's computer fails but the SSD is still intact. This process occurs after a logic board repair.

Important:

- This method is for technician use only. If a user wishes to transfer data from his or her own Mac or Windows computer, refer to article [HT204754: Move content to your new MacBook or MacBook Pro](#).
- The CDM Tool flex cable must be replaced after it has been connected to the logic board 30 times. Refer to the end of this article for instruction on how to replace the flex cable.

This article contains the following sections:

- Tools
- First Steps
- Data Migration
- Troubleshooting
- Disconnecting the CDM Tool
- Replacing the CDM Tool Flex Cable

For video instruction, refer to article [SV326: Customer Data Migration \(CDM\) Tool](#).

Tools

- CDM Tool Kit (076-00236), which includes:
 - CDM Tool (661-05097)
 - CDM Tool flex cable (923-01127, 3-pack)
 - Power cord, 923-00672 (part number prefix will indicate country, i.e., CH923-00672 for China)
 - Power brick, 923-01129
 - USB-C to USB-C cable (this is a USB-C 3 cable and is the only data transfer cable that is supported for this process) (923-01131)
 - Logic board holder (923-01130)
- Torx T3 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- Black stick

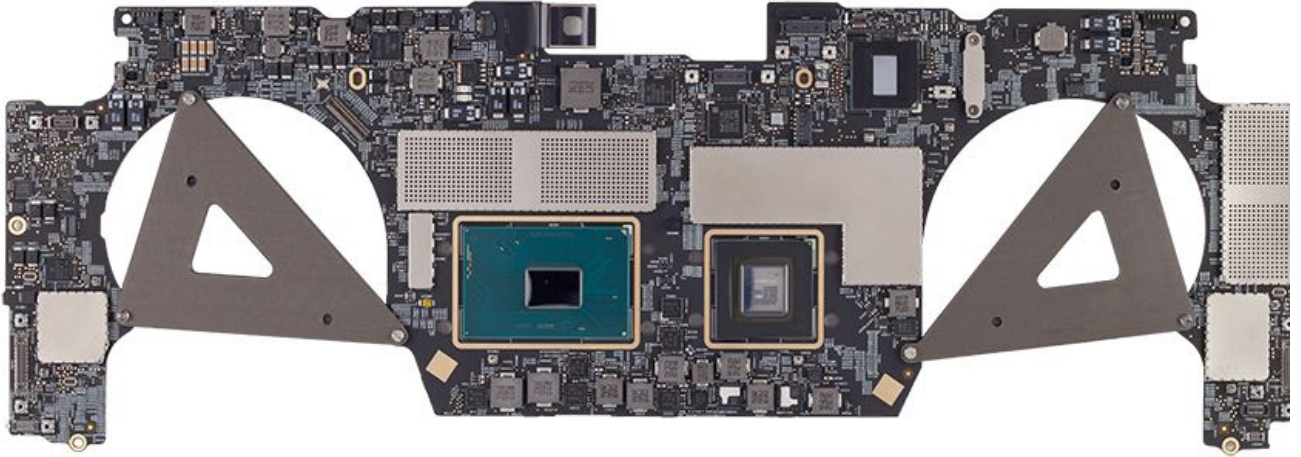




First Steps

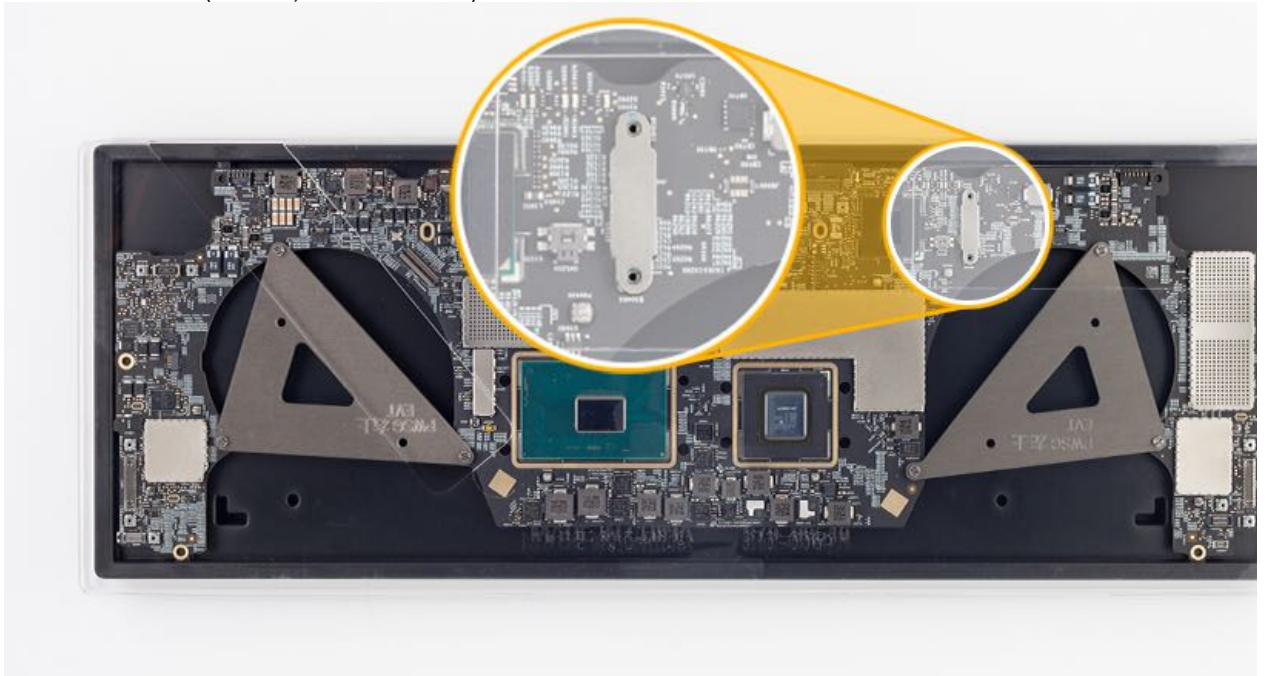
Important: The repaired computer must be running macOS Sierra.

1. Install the logic board stiffeners.

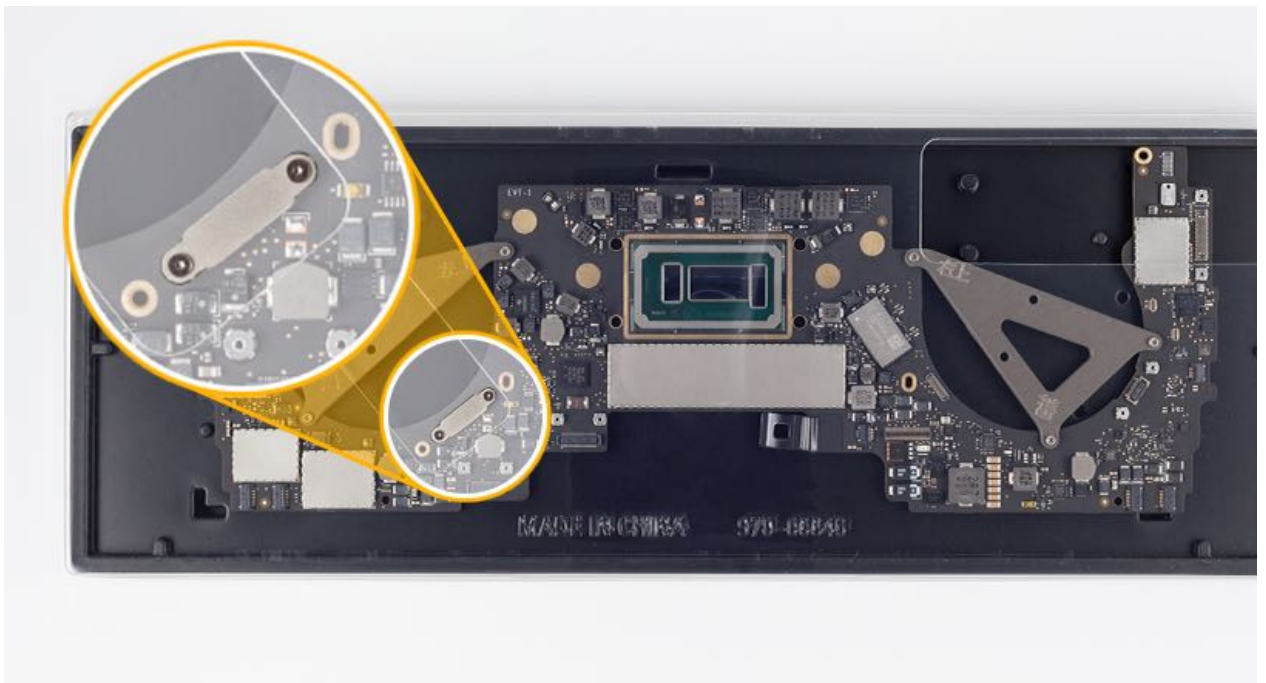


2. Place the logic board that was removed from the computer into the logic board holder. **Note:** The CDM Tool connector is located on different areas of the logic board on MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016 and 2017). The logic board holder is set up to accommodate both.

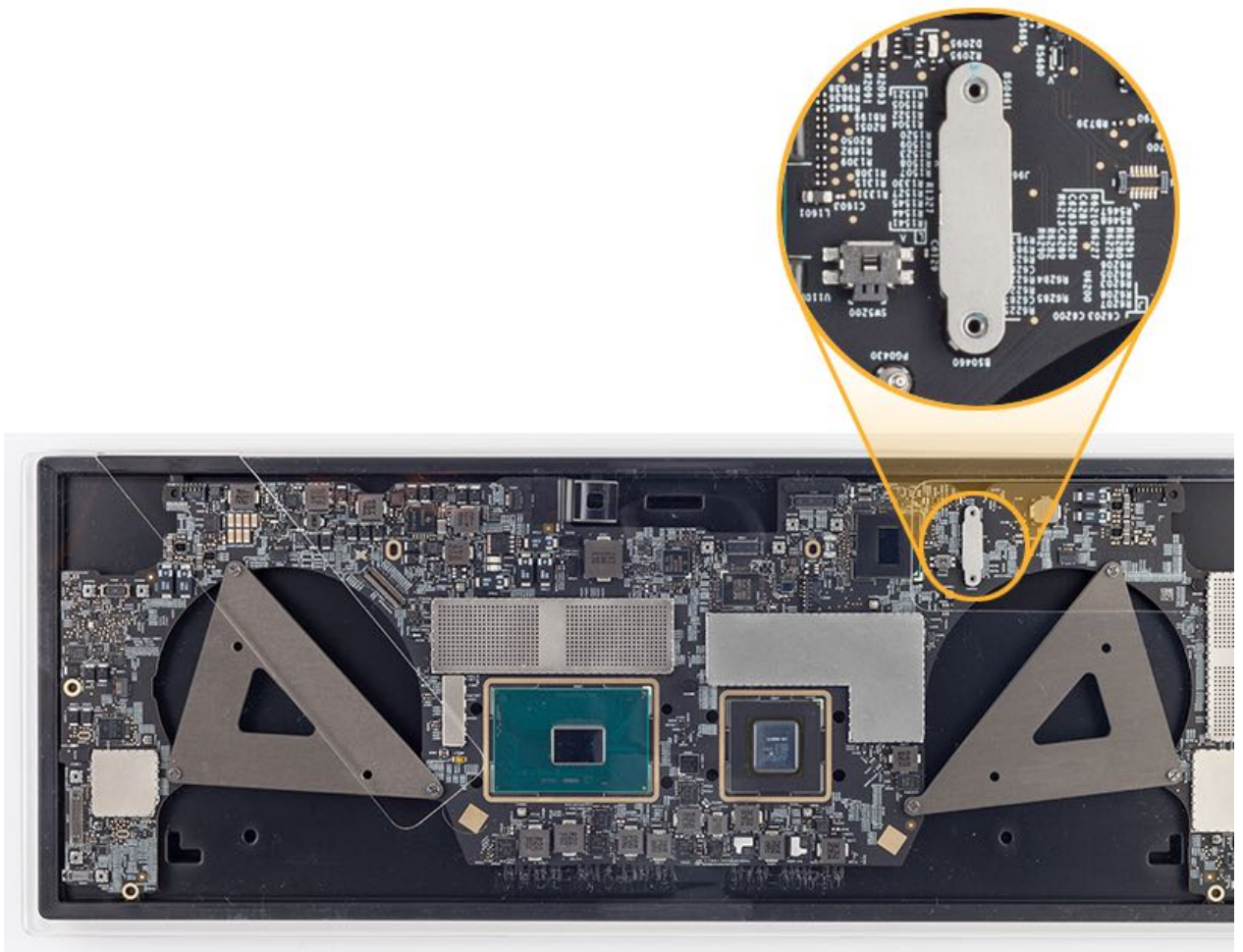
- For MacBook Pro (15-inch, 2016 and 2017)



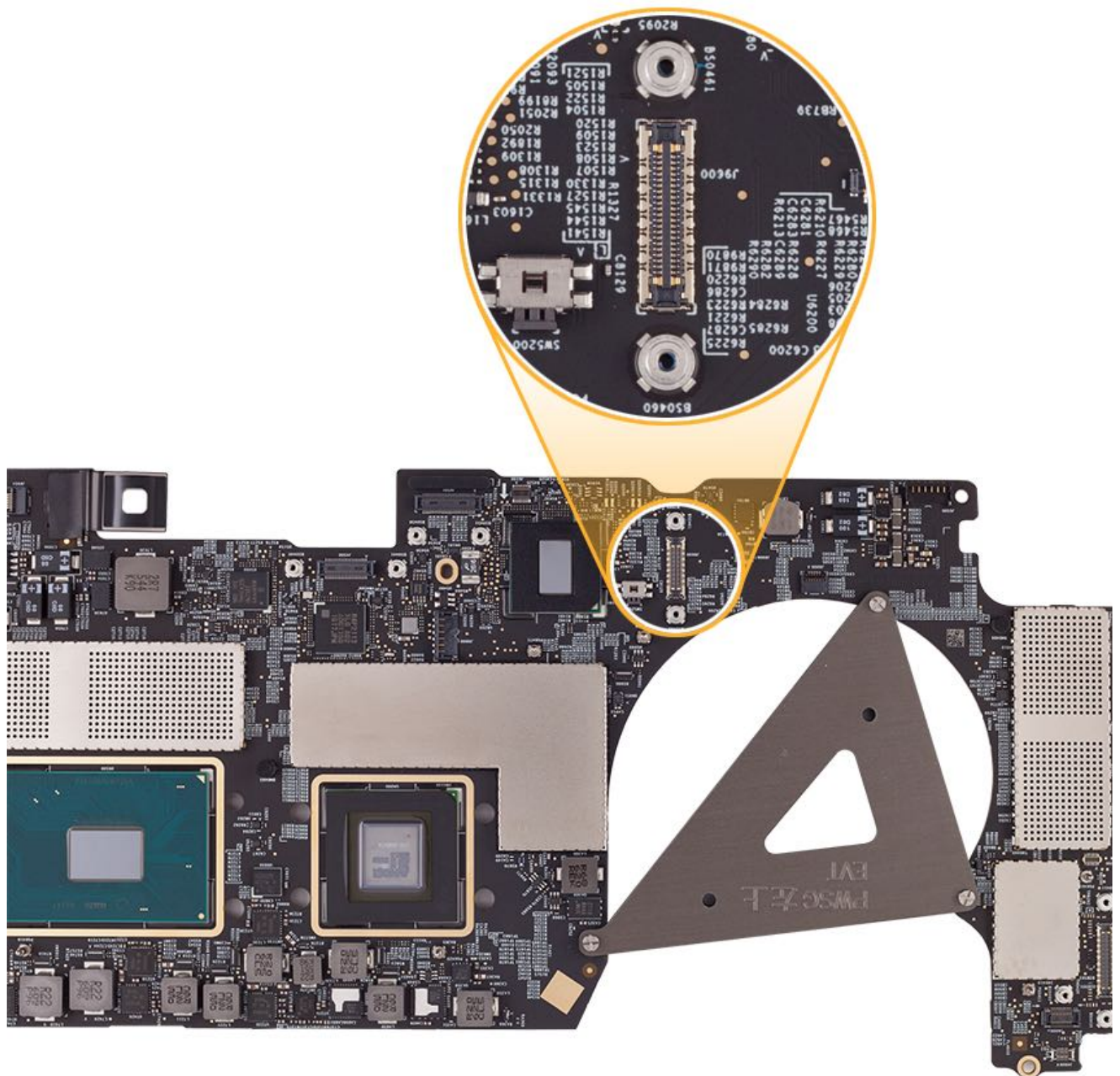
- For MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports)



3. Remove two T3 screws from the CDM Tool connector.
 - T3: 923-01411



4. Inspect the CDM Tool connector on the logic board. If any pins are bent or if the connector is damaged, then the data cannot be transferred.

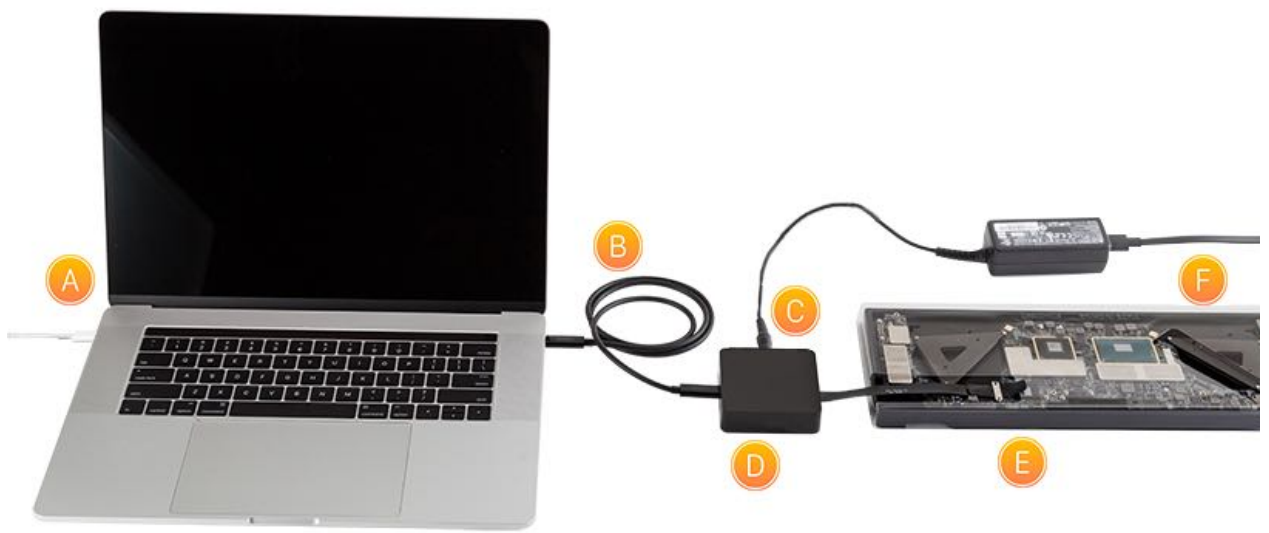


5. Inspect the CDM Tool flex cable to make sure there are no damaged pins. If any pins are damaged, then replace the cable.



Note:

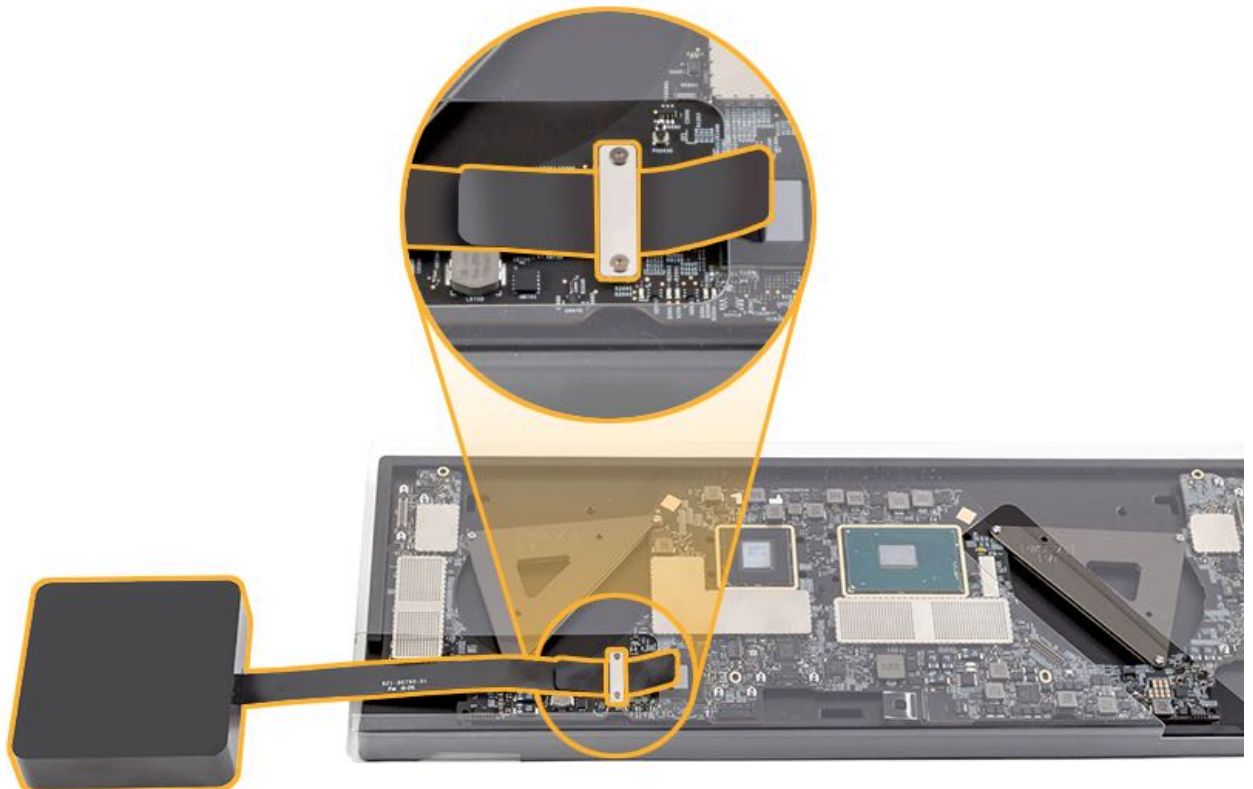
- The CDM Tool flex cable must be replaced after it has been connected to the logic board 30 times, regardless of whether or not a data migration has taken place. Use the life cycle check sheet that can be downloaded from article [SM267: Flex Cable Life Cycle Counter](#) to keep track of the number of times the cable has been connected to the logic board. Once you have checked 30 boxes, replace the cable.
- Be sure the repaired computer has a power adapter attached during this process.



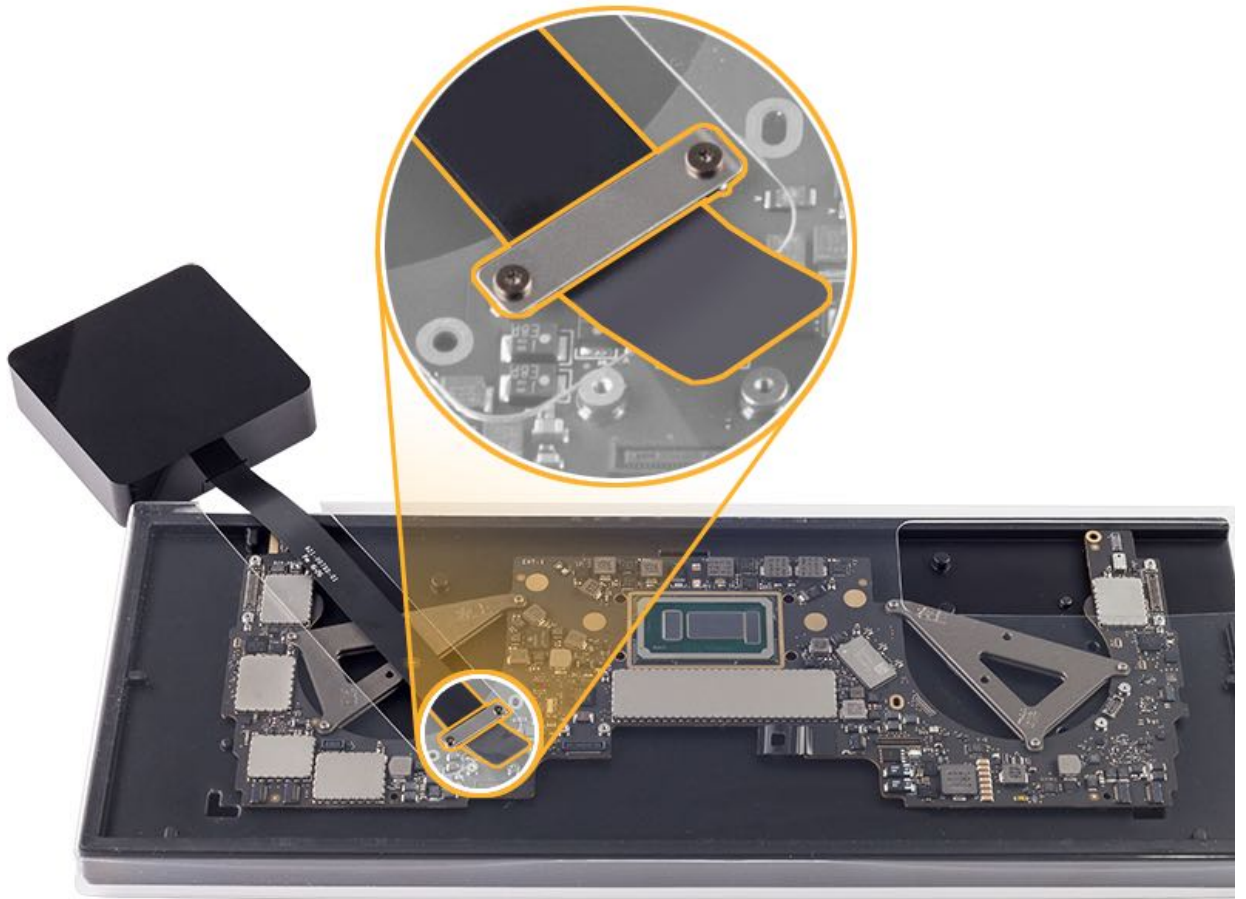
- A. Computer power adapter
- B. USB-C to USB-C cable
- C. CDM Tool power adapter
- D. CDM Tool with flex cable attached
- E. CDM flex cable attached to KBB logic board
- F. KBB logic board in holder

Data Migration

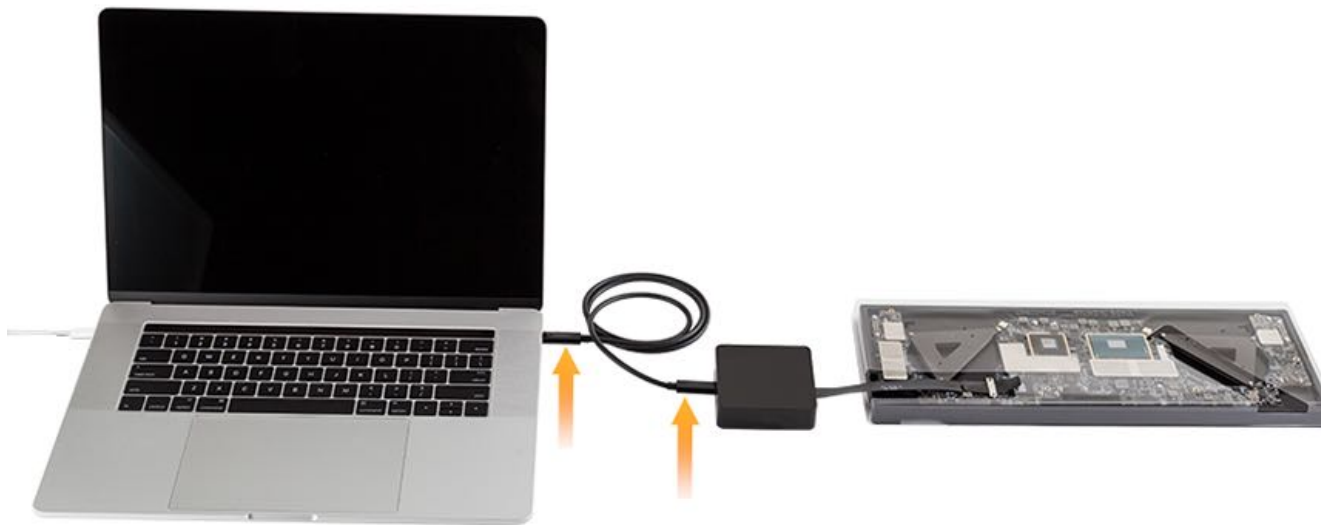
1. Connect the CDM flex cable to the CDM connector on the KBB logic board. Secure the connector with the two T3 screws to insure proper connection.
 - MacBook Pro (15-inch, 2016 and 2017)



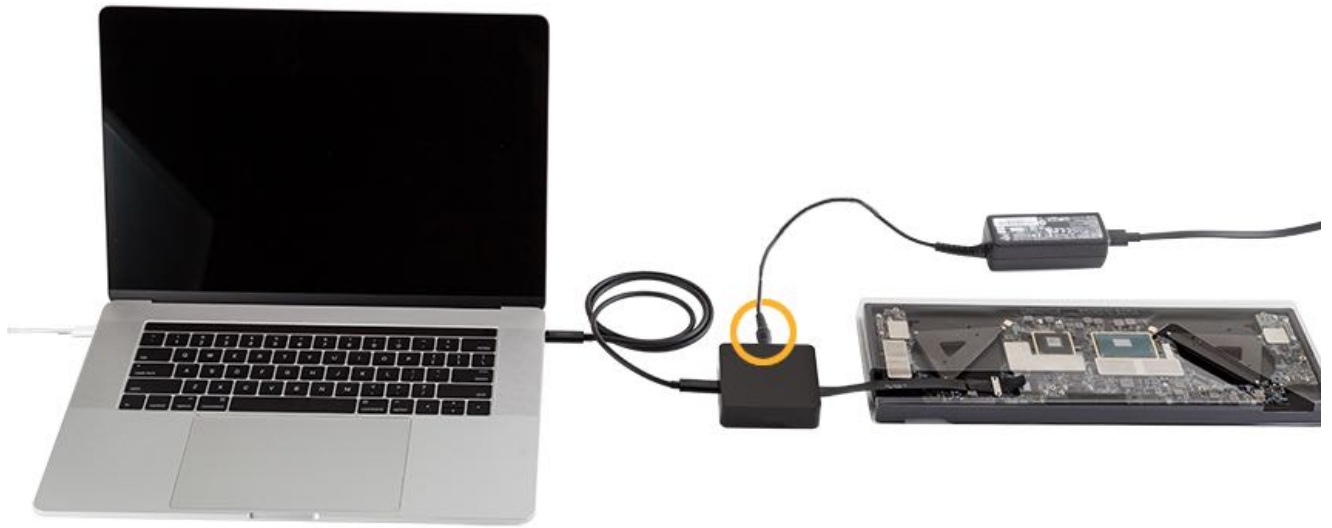
- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports)



2. Connect the USB-C to USB-C cable from the repaired computer to CDM Tool.



3. Connect the power adapter to the CDM Tool.
Note: There is an LED on the power adapter to indicate that power has been attached.



4. Power on the repaired computer.
5. Open the Migration Assistant on the repaired computer and proceed with the steps for data migration.

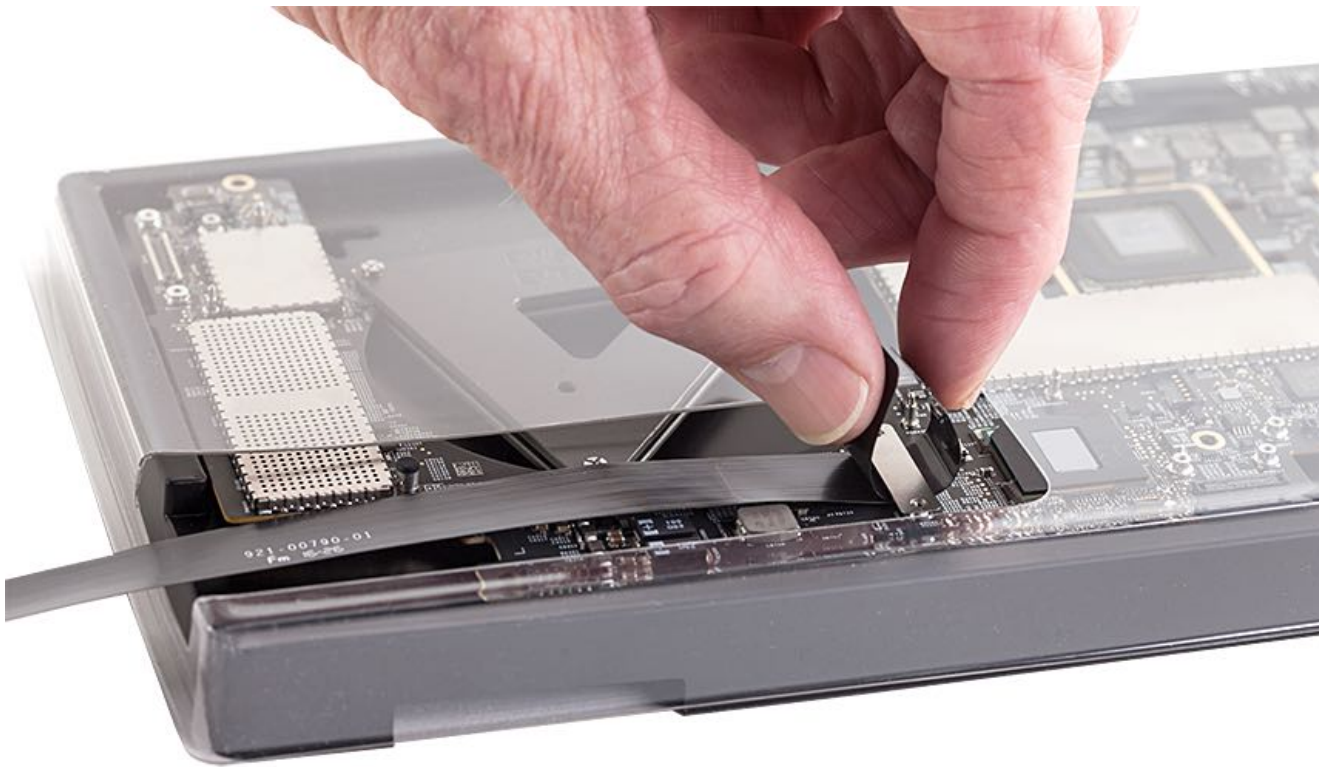
Troubleshooting

If the volume is not recognized in Migration Assistant, check that it appears in Disk Utility. If the defective logic board's flash storage is not recognized by the destination Mac in either Migration Assistant or Disk Utility, try the following steps in order:

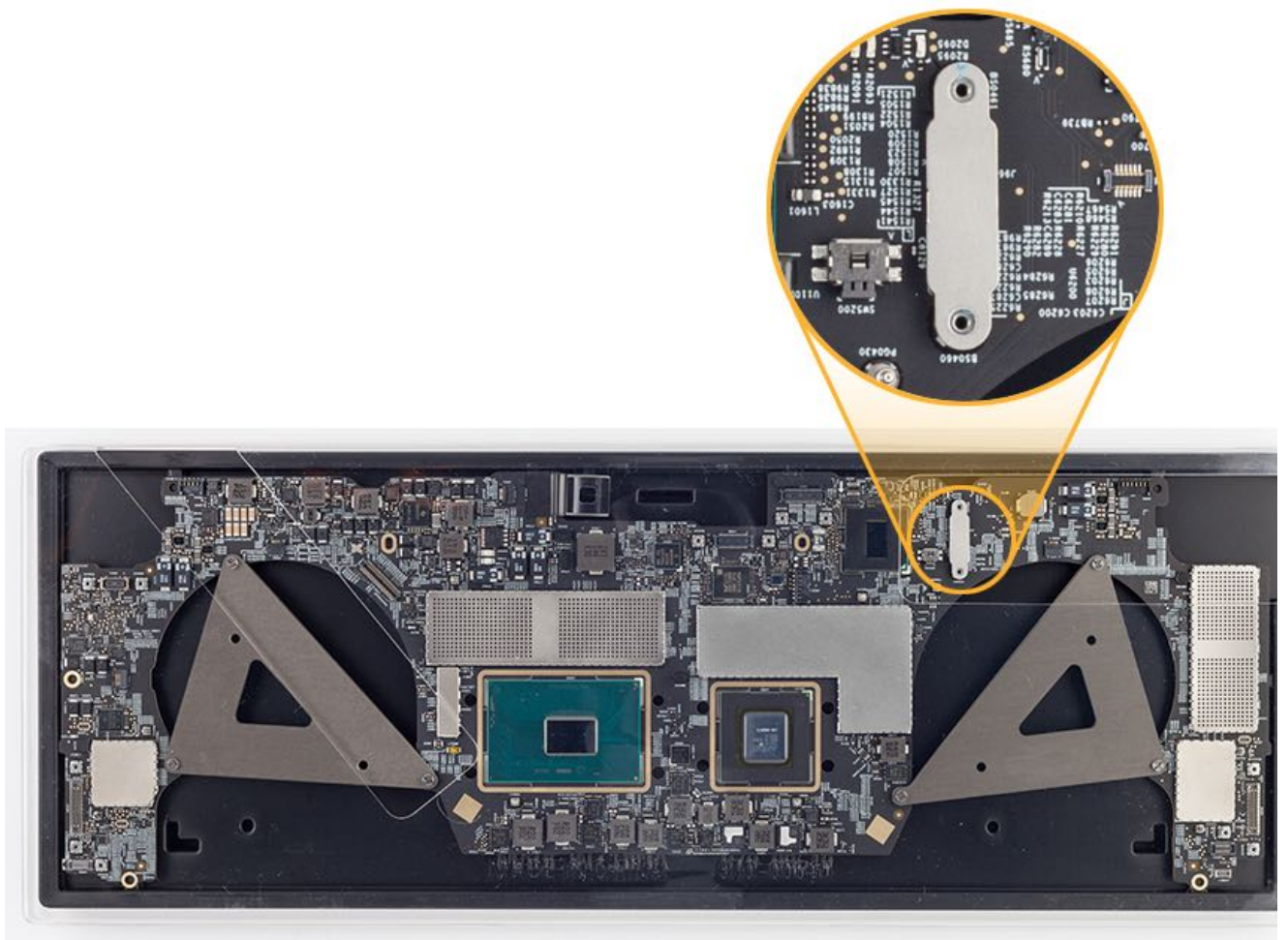
1. Check the CDM Tool flex cable orientation. The CDM Tool is always seated on the left side of the defective logic board.
2. Verify that the CDM Tool power adapter is receiving and providing power, by observing that its green LED is on. If not, try another power outlet or another power adapter.
3. Verify that the CDM Tool has power, by observing that its LED is on. If not, check the power adapter connection to the CDM Tool.
4. Replace the USB-C cable with a known-good cable of the same type.
5. Test another defective logic board if available. If none are available, or if a good logic board also fails, skip to step 6.
6. Replace the CDM Tool flex cable.
7. Replace the CDM Tool.

Disconnecting the CDM Tool

1. Disconnect the power source from the CDM Tool.
2. Disconnect the USB-C to USB-C from the CDM Tool.
3. Remove two T3 screws from the CDM Tool connector on the KBB logic board.
4. Disconnect the CDM Tool flex cable by grasping both pull tabs and gently pulling straight up.



5. Reinstall the CDM Tool connector cowling and the two T3 screws.



6. Store the CDM Tool in the box in which it was shipped. **Caution:** Do not wrap the CDM Tool flex cable around the tool or the cable will have to be replaced.

Replacing the CDM Tool Flex Cable

Important: The CDM Tool flex cable must be replaced after it has been connected to the logic board 30 times, regardless of whether or not a data migration has taken place. Use the life cycle check sheet that can be downloaded from article [SM267: Flex Cable Life Cycle Counter](#) to keep track of the number of times the cable has been connected to the logic board. Once you have checked 30 boxes, replace the cable.

1. Turn the CDM Tool over and remove two T3 screws.



2. Remove two T5 screws from the flex cowling.



3. Disconnect the flex cable with the flat end of a black stick.



4. Replace the flex cable with a new one (923-01127).
5. Reinstall cowling screws.
6. Reinstall CDM Tool screws.

Touch ID Board

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

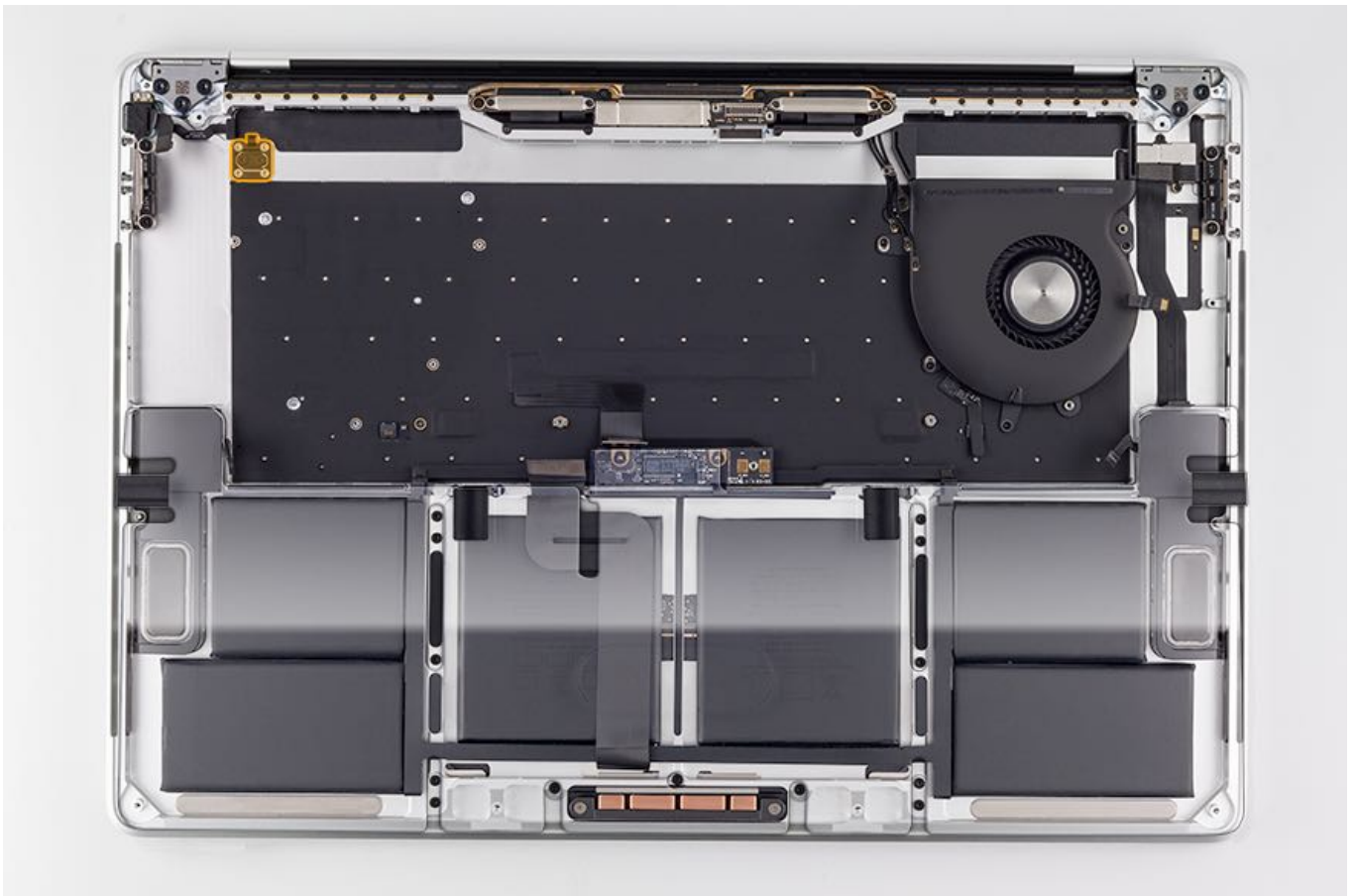
Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)
- [Logic board](#)
- [Right fan](#)

For video instruction, refer to article [SV330: Touch ID Replacement Video](#).



Tools

- ESD wrist strap
- Alignment kit including Touch ID alignment tool and edge guide (923-01586) **Note:** Your tool may differ in color.
- Torx T3 screwdriver
- ESD-safe tweezers
- Protective battery cover (923-01320)

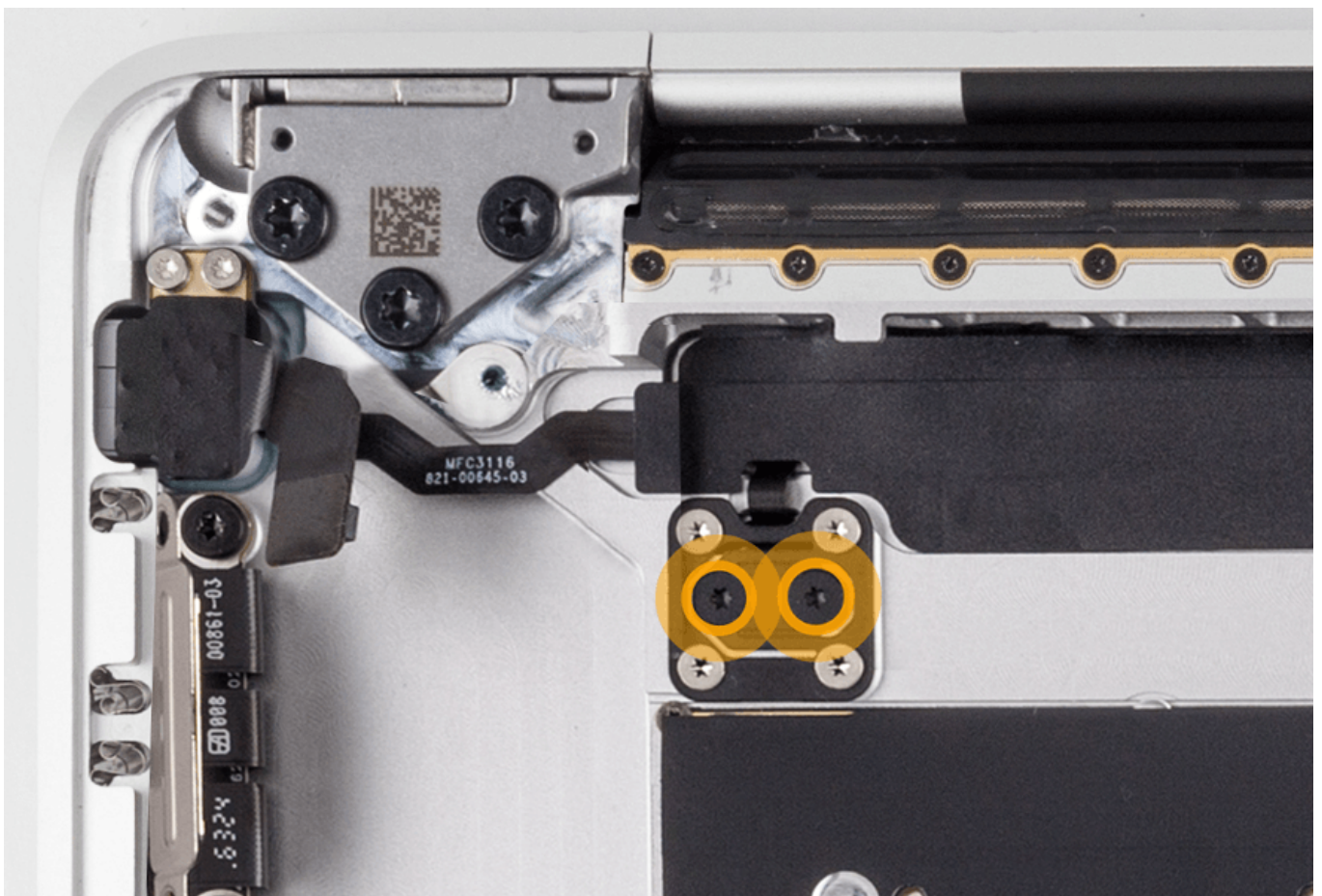


Steps For Removal

Important: The Touch ID is paired with the logic board. When the Touch ID is replaced the logic board must also be replaced.

1. Remove the two identical T3 screws from the center of the flexure.

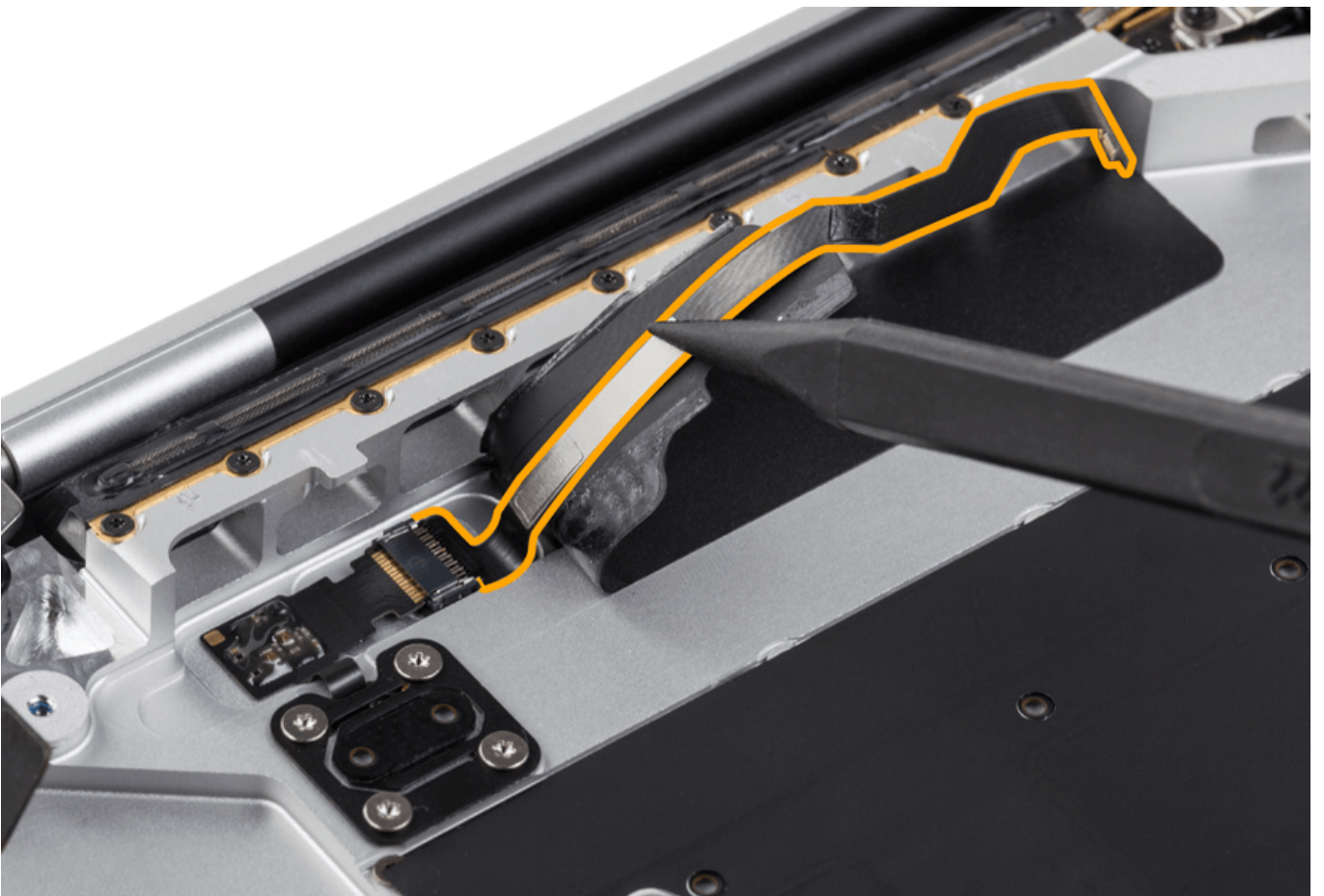
- T3: 923-01442



2. With a black stick, peel up the mylar that is covering the Touch ID flex cable.



3. Gently hold back the flex cable with a black stick to expose the locking lever connector.



4. After flipping up the locking lever, use tweezers to disconnect the flex cable.



5. With the flat end of a black stick, peel up the flex cable from the top case.



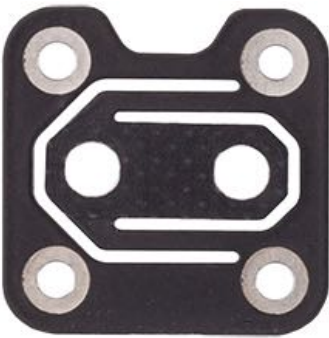
6. Remove the four T3 screws from the corners of the flexure.

- T3: 923-01443

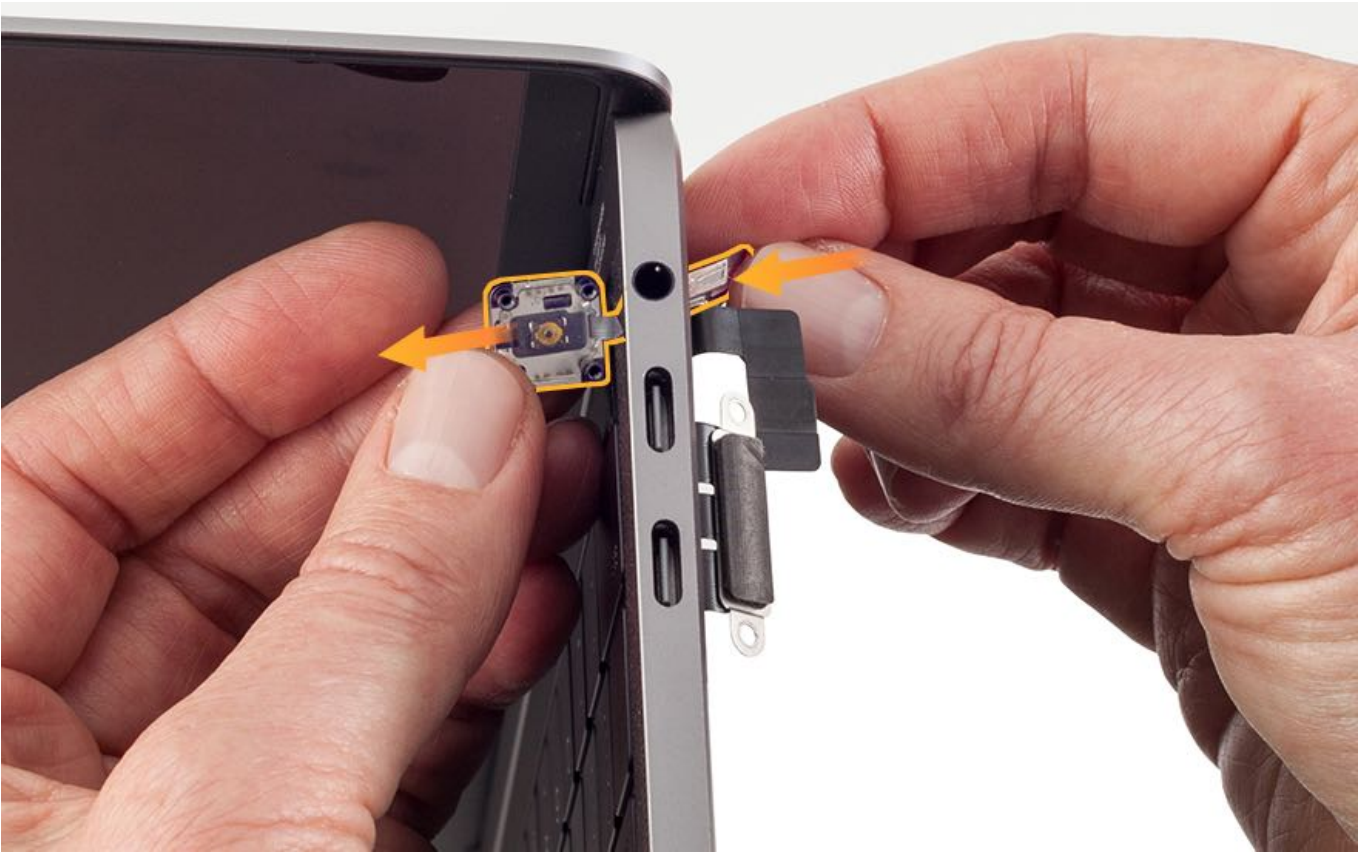


7. Use tweezers to remove the flexure from the top case.

Note: The outside border of the flexure is keyed on one edge to fit the flex cable. This indicates the proper orientation when reinstalling the flexure.



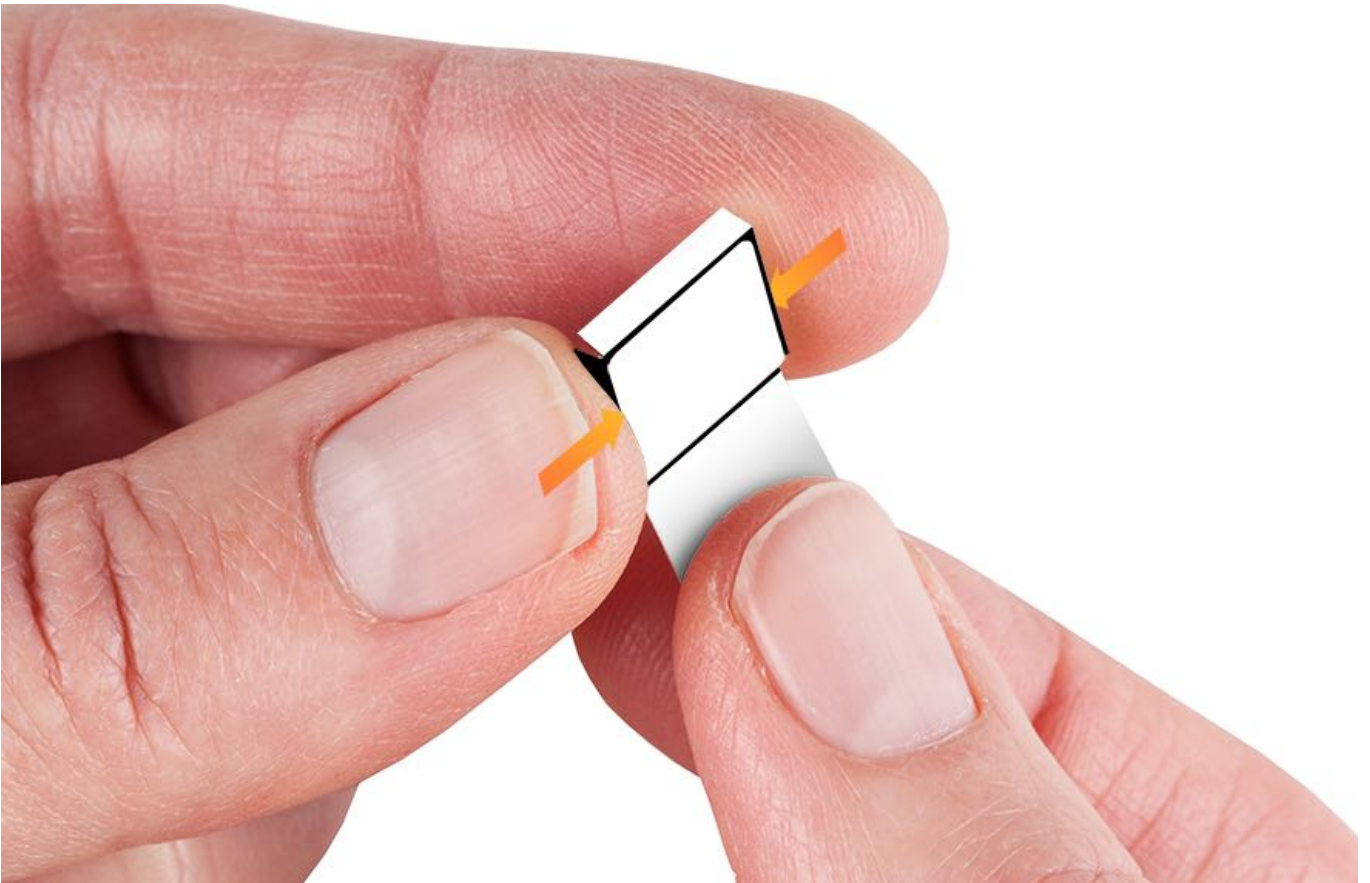
8. Open the display and stand the computer assembly on its side. With a hand on each side of the top case, support the Touch ID board as you thread the flex cable through the slot. Remove the Touch ID board from the keyboard side of the top case.



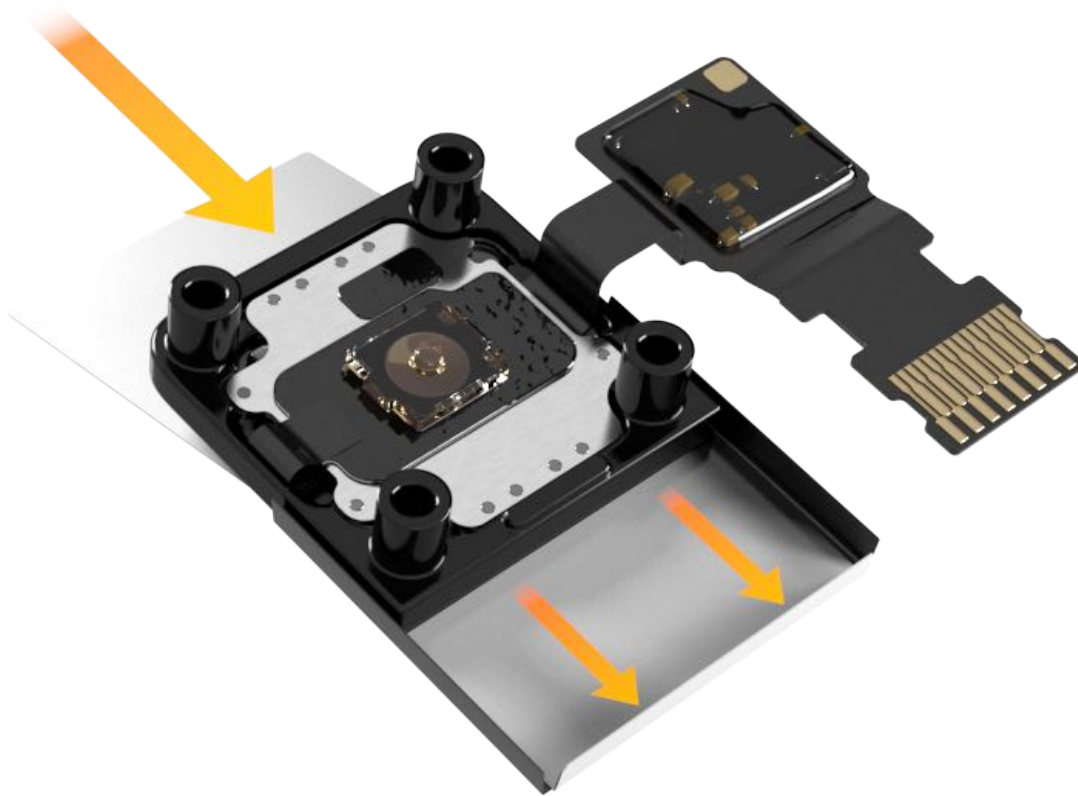
Steps For Reassembly

Note: If you are installing a replacement Touch ID board, remove the protective film on the glass surface.

1. Holding the long tab on the Touch ID alignment tool, squeeze the three perforated flaps so they are 90 degrees or so to the square surface. If the flaps are too open, they will not grip the Touch ID board correctly.



2. While holding the long tab, slide the Touch ID board inside the Touch ID alignment tool, as shown.



3. With the computer on its side, support the tool and the board as you thread the flex cable through the slot in the top case.



4. Verify the three flaps of the tool insert into the Touch ID bay.

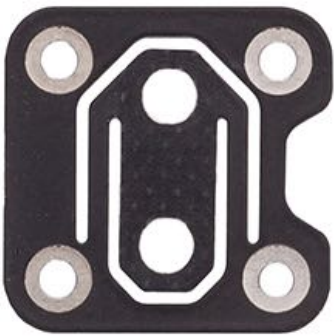


5. Hold the Touch ID alignment tool in place.
6. Reinstall the flexure and four corner screws on the other side of the top case.

- T3: 923-01443



Note: The flexure has a keyed edge that fits the flex cable. Before installing screws, verify the four silver circles are visible. If you do not see the silver circles, flip over the flexure.



7. Remove the alignment tool, and place the computer flat on the ESD mat. **Note:** Be sure the battery cover is in place and the flex cables are not bent or stressed.



8. Press the Touch ID button to verify it makes a clicking noise. If the button does not move at all or moves but does not click, refer to article [RP1354: Touch ID Shim](#) for details.

9. If the click is correct, reattach the alignment tool.

10. Put the computer on its edge, hold the alignment tool in place. Put the edge guide over the tab so it is flush with the edge of the top case.



11. Press lightly on the edge guide while reinstalling the two center screws in the middle of the flexure.



12. Place the computer flat on the ESD mat and look directly over the Touch ID square. The spaces surrounding each side

should appear equal and the Touch ID should align seamlessly with the Touch Bar.



13. Insert the tab of the alignment tool into all four sides of the Touch ID platform. The side between the Touch ID and the Touch Bar has a tighter fit.



14. Reconnect the Touch ID board flex cable. Be sure to tamp down the mylar.

15. Reinstall the [right fan](#).

16. If you are installing a new Touch ID board, you must install a new [logic board](#).

17. Reinstall the [clutch covers](#).

18. Reconnect the [battery](#) and remove the battery cover.

19. Reinstall the [bottom case](#).

20. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).

21. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Touch ID Shim

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).
- The logic board is paired with the Touch ID board. When replacing one, you must replace the other. Refer to article [RP1301: Touch ID](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)
- [Logic board](#)



Tools

- ESD wrist strap
- Torx T3 screwdriver (magnetized)
- ESD-safe round-nose tweezers
- Battery cover (923-01320)
- Shim kit, package of 3 (923-01519), not shown



Steps For Removal

Note: The Touch ID shim is a tiny, circular part. Make sure your work surface is completely clean. A clean surface allows easy location of the shim if it lands onto the ESD mat during this repair.

1. Press the Touch ID button a few times to check its response:

- If the button feels too loose or does not click, a larger Touch ID shim is required.
- If the button feels too stiff or does not move, a smaller Touch ID shim is required.



2. Refer to article [RP1301: Touch ID Board](#) to remove the Touch ID board.

3. Spread the tips of the round-nose tweezers, and use one tip to push the Touch ID shim out.



4. Retrieve the loose shim on the keyboard side of the top case. The Touch ID shim has a small bit of adhesive and may stick to the top case. The shim is black on the adhesive side and silver on the opposite side.





Steps For Reassembly

1. Replace the Touch ID shim with one of the supplied shims from the kit (923-01519), which are marked and organized by size.
 - Using tweezers, remove the appropriate shim from the backing.
 - Keep less than half of the shim on the tweezer head for easier installation.
2. Set computer flat on the ESD mat. **Important:** Be sure the battery cover is in position and the left and right I/O boards are flat.



3. Align the shim in the recessed circle on the top case.



4. Press the shim gently to activate the adhesive.



5. Refer to the following articles to complete the repair:
 - [RP1301: Touch ID](#) to reinstall the Touch ID board to the top case and confirm that the new shim clicks and functions correctly.
 - [RP1300: Logic Board](#) to reinstall the logic board.
6. Reassemble the computer.
7. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
8. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Heat Sink

First Steps



Warning:

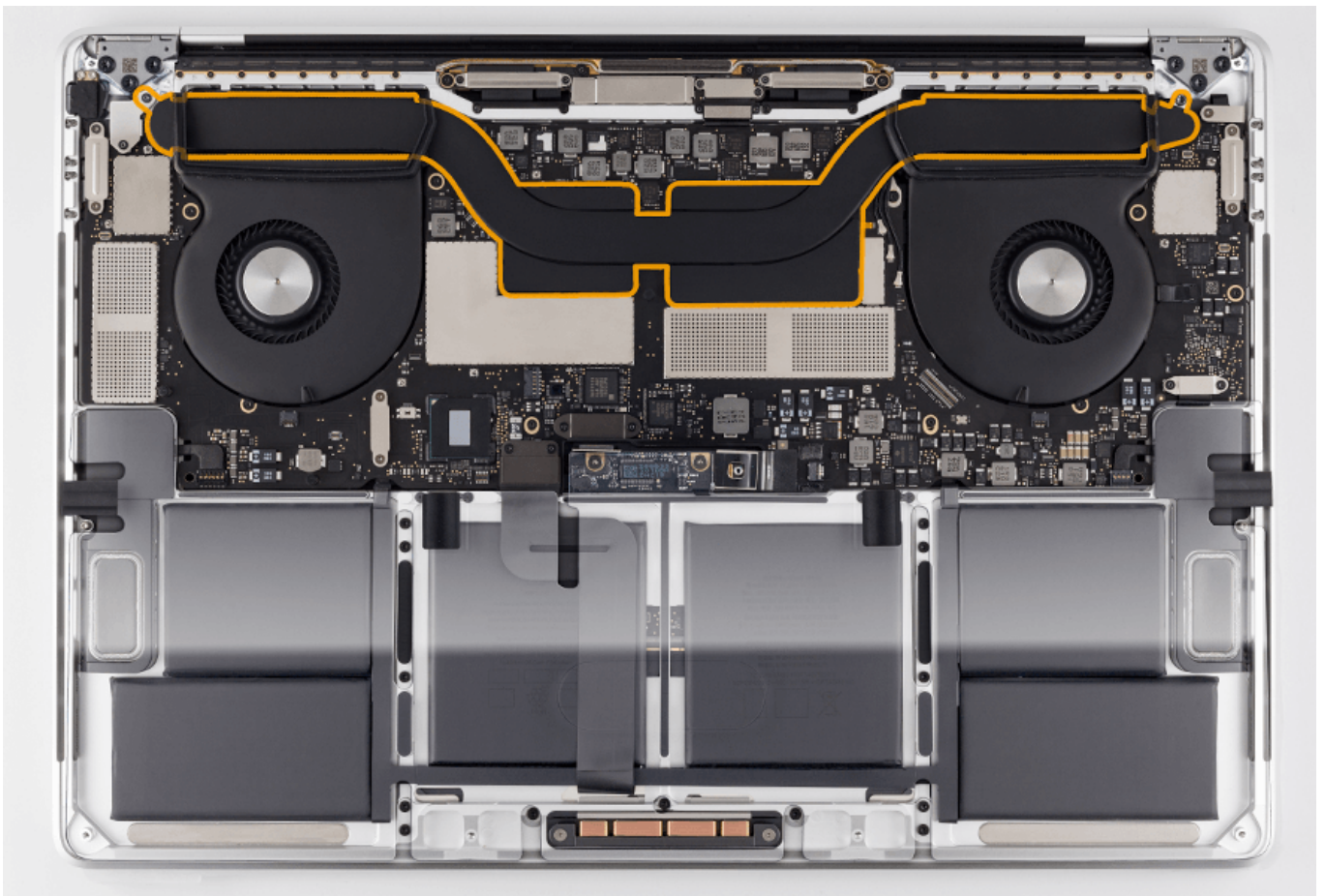
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)
- [Logic board](#)



Tools

- Torx T5
- Thermal grease syringe (922-7144)
- ESD wrist strap
- Isopropyl alcohol (IPA) wipes
- Protective battery cover (923-01320)



Steps For Removal

1. Turn the logic board over. Place the board on an ESD mat. Remove four T5 flexure screws from the CPU and four T5 flexure screws from the GPU.

- T5: Four 923-01507 (GPU)

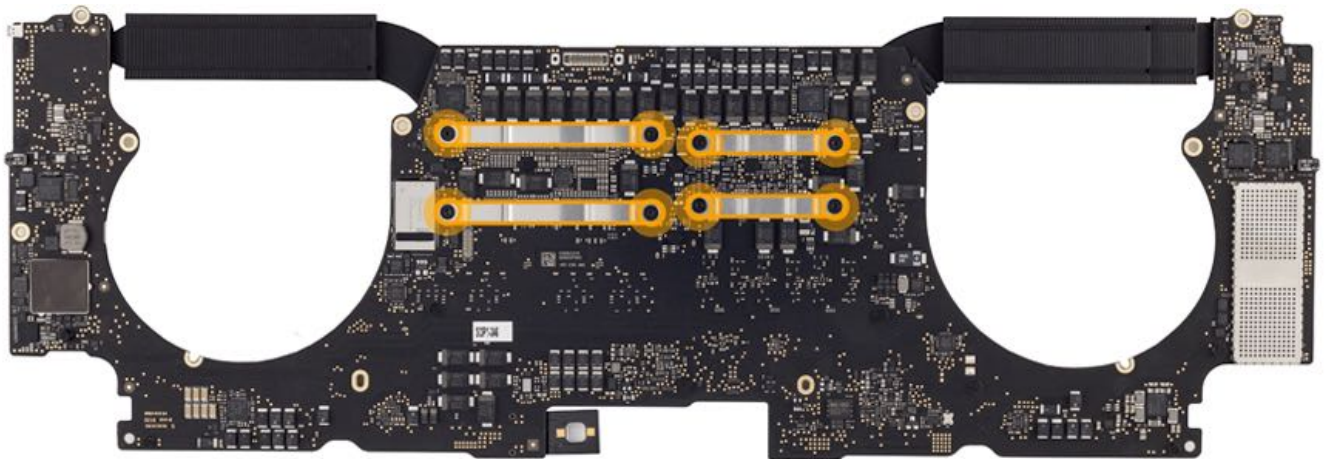


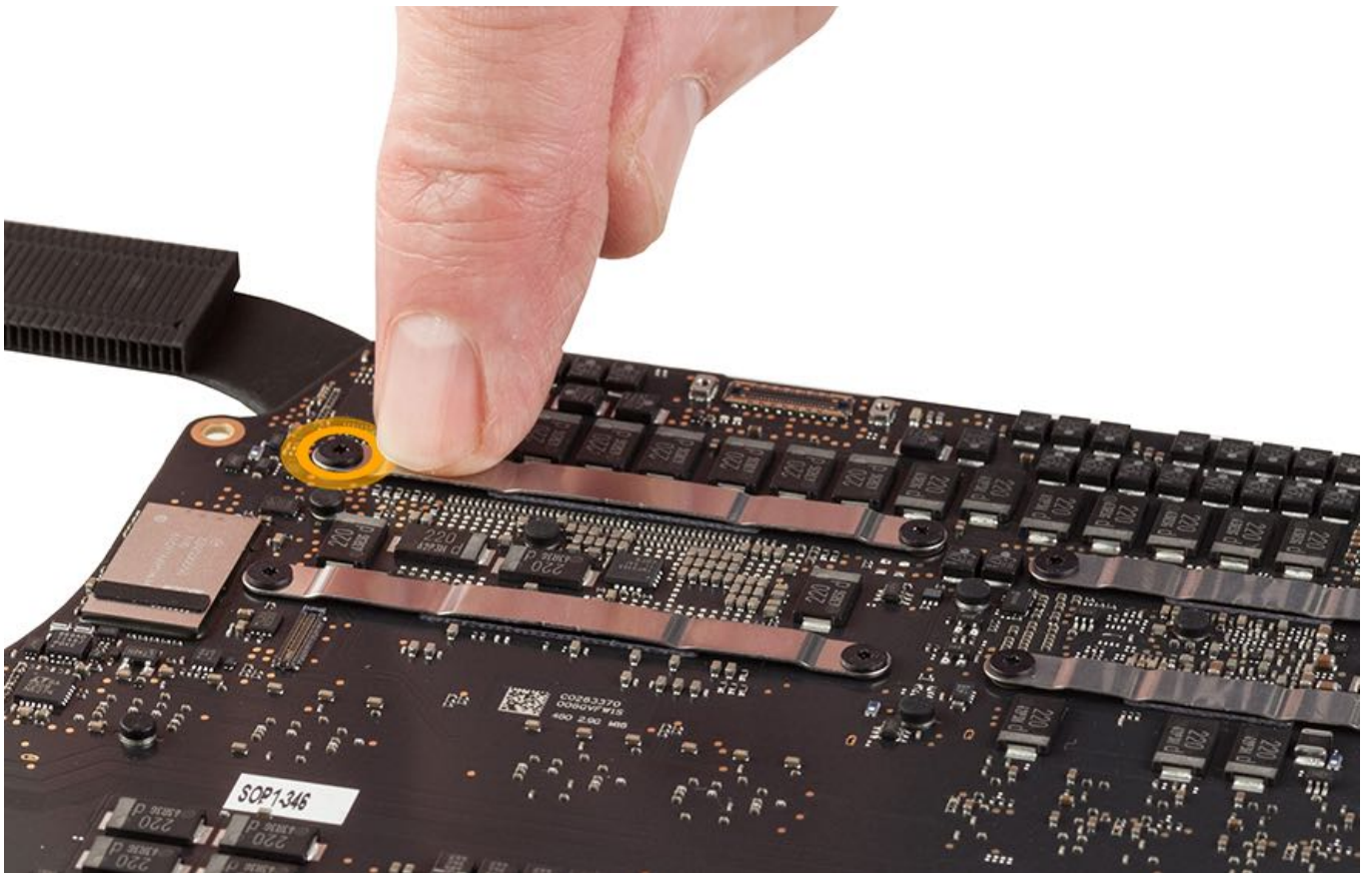
- T5: Four 923-01508 (CPU)



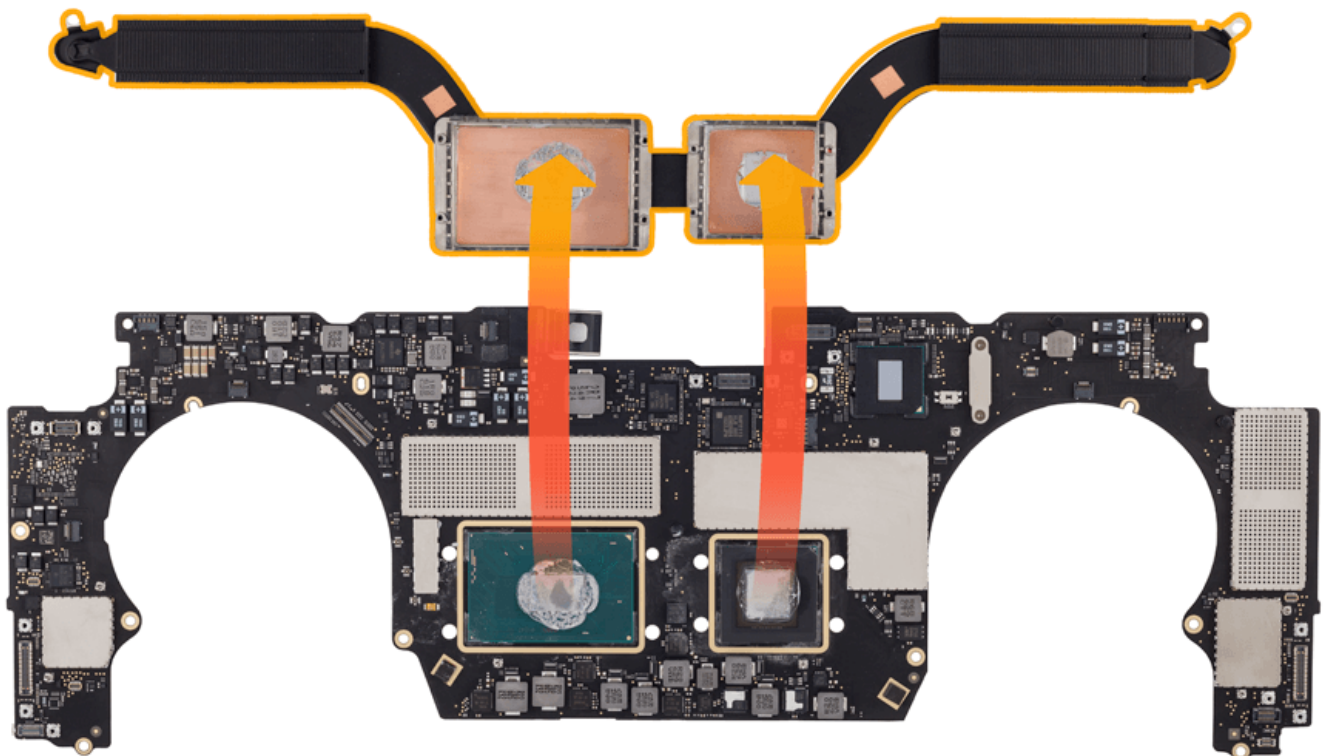
Note:

- The CPU flexures are longer than the GPU flexures.
- The heat sink flexures are under tension. Gently hold down the flexure when removing the screws on each flexure clip.



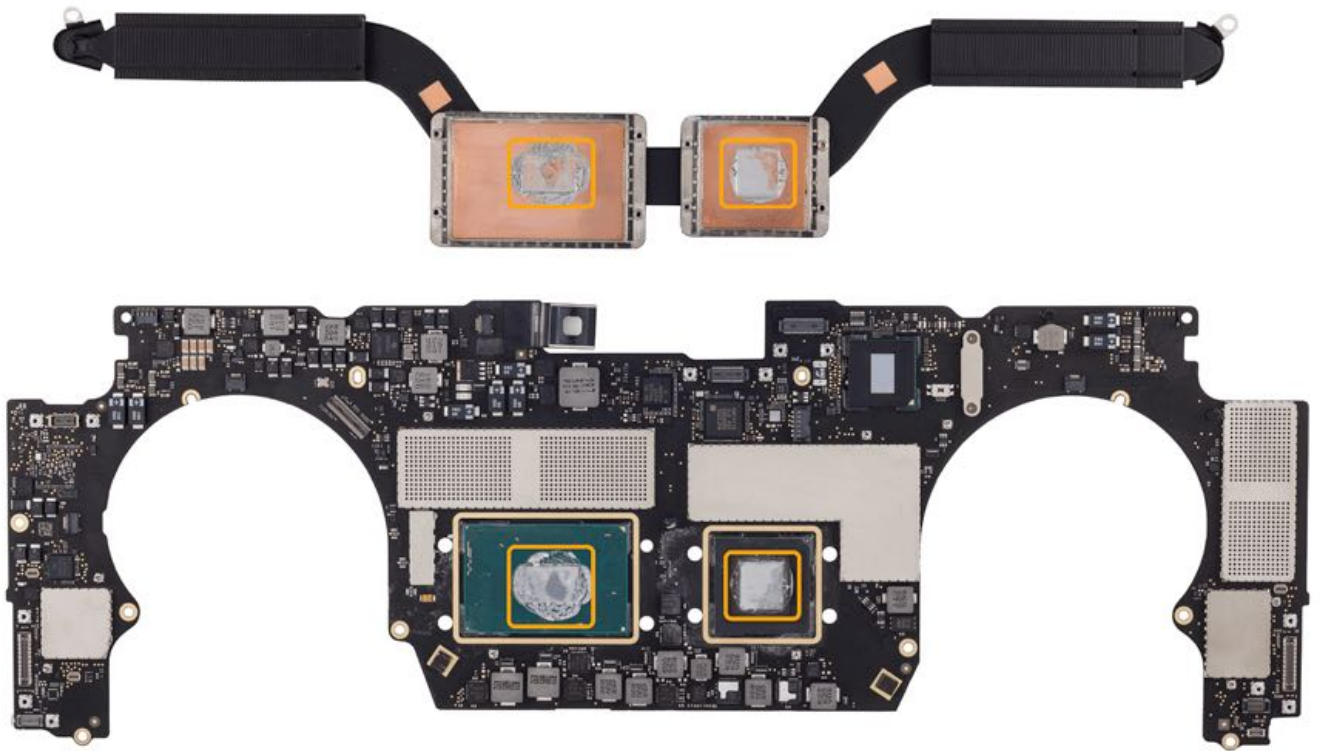


2. Gently lift the heat sink from the logic board. **Note:** Always hold the heat sink by the body, never by the heat sink arm.

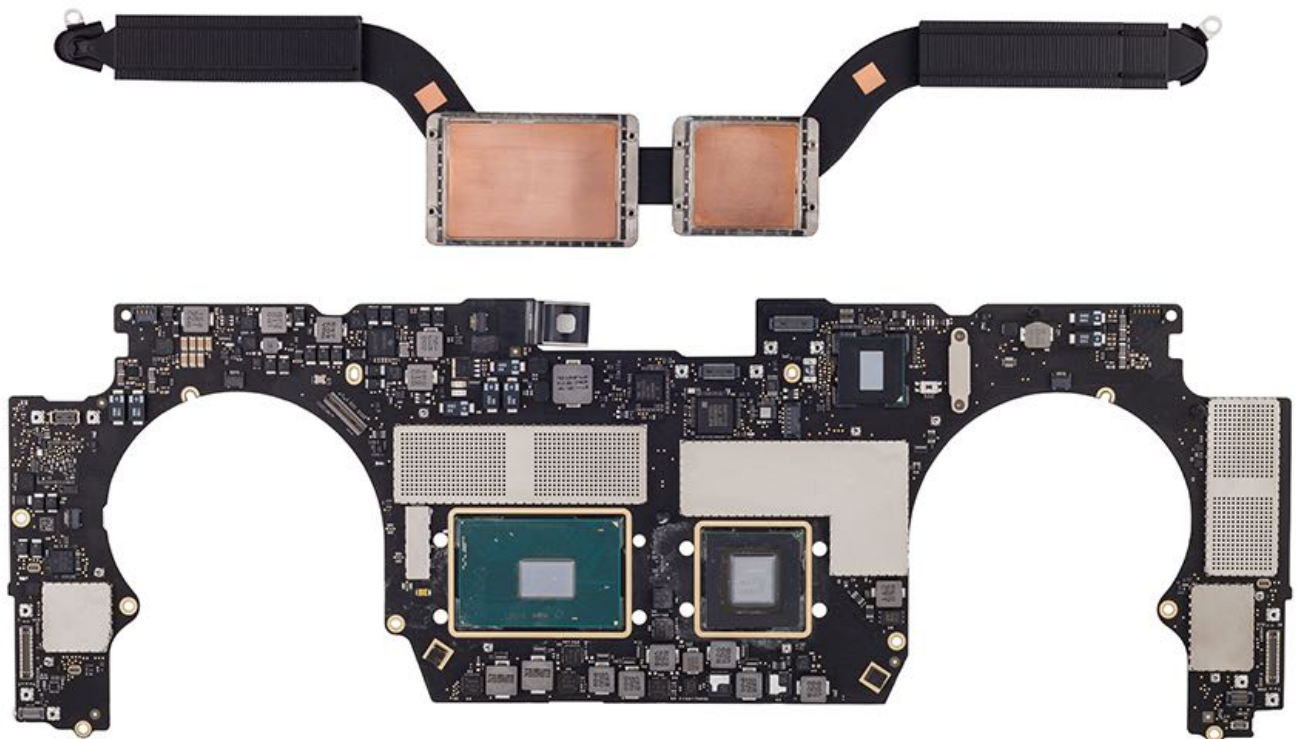


3. Use IPA wipes to clean the thermal grease from the heat sink and processor chip.

Before cleaning:

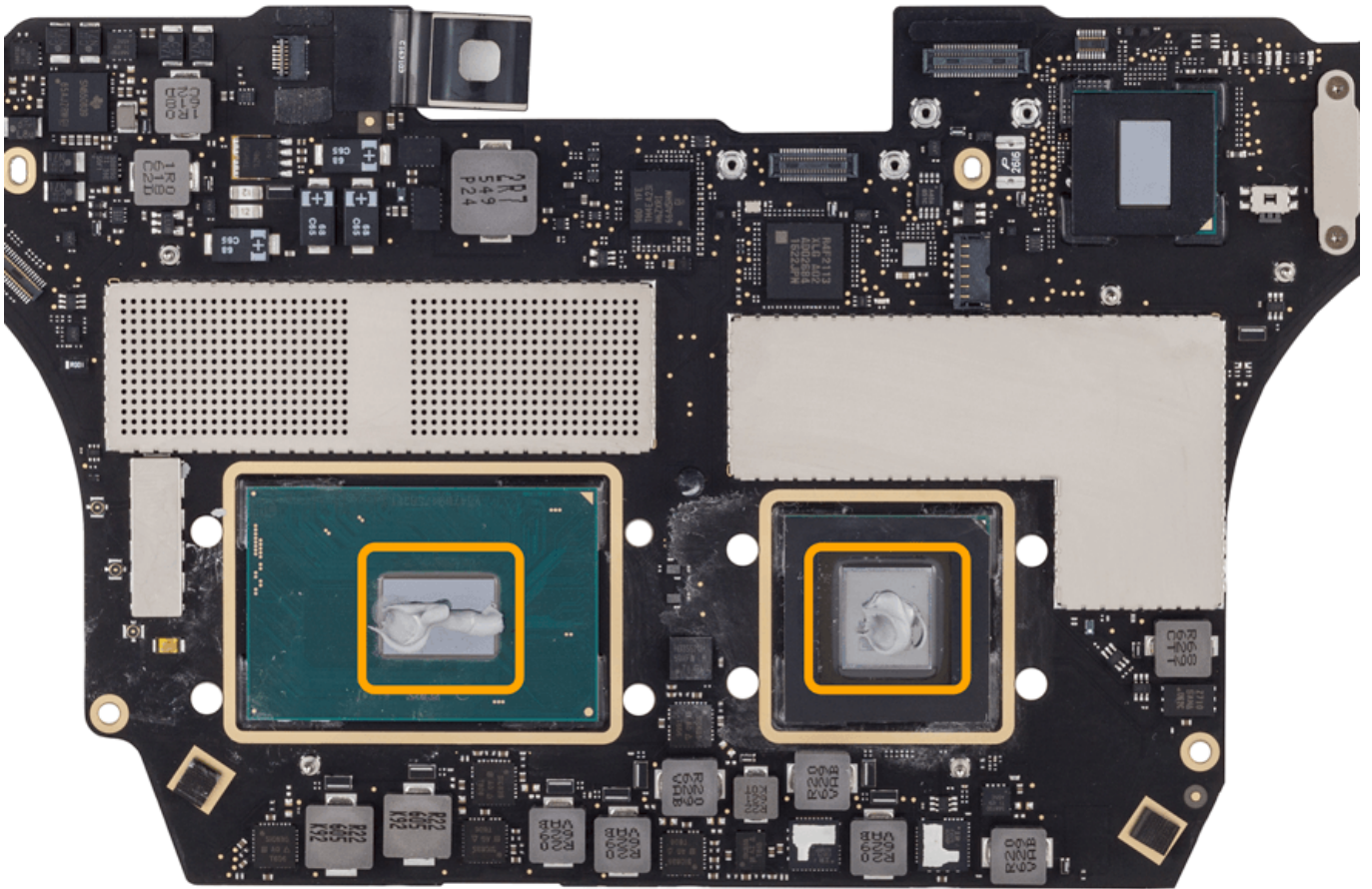


After cleaning:

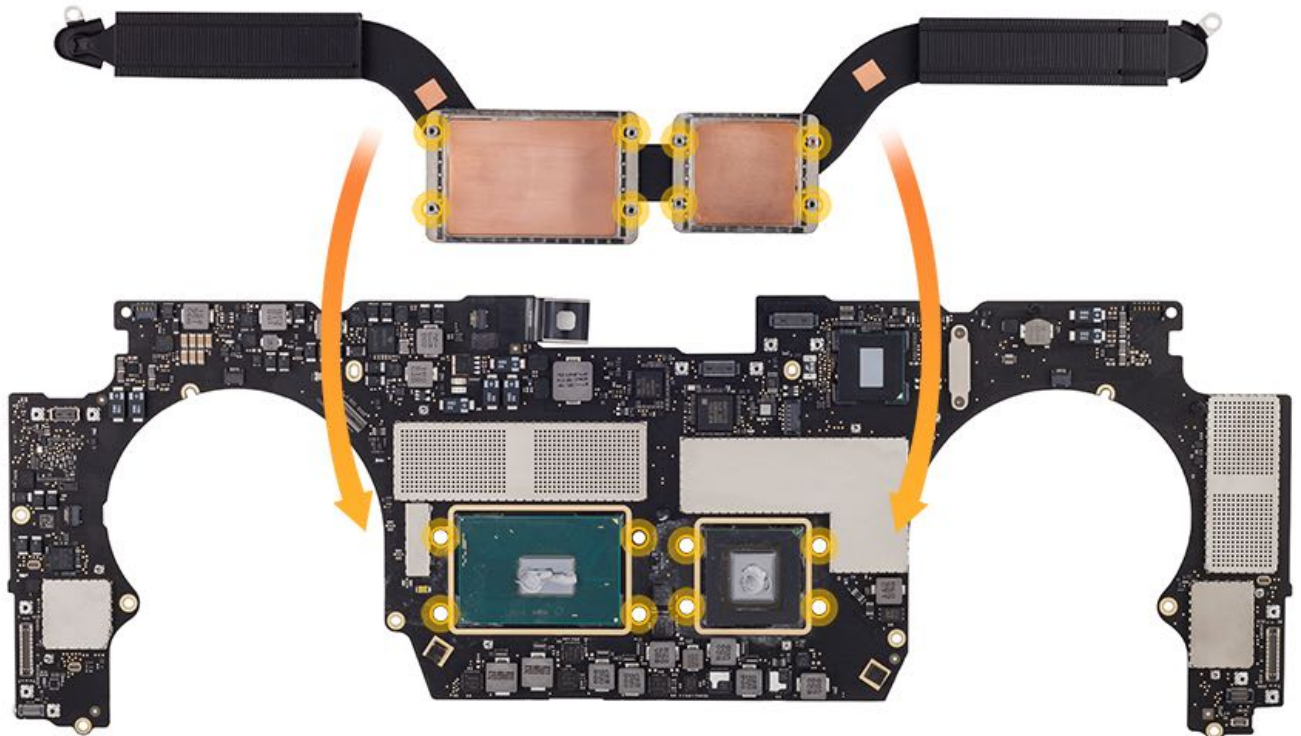


Steps For Reassembly

1. Using the thermal paste syringe, inject half of the paste on each processor chip.



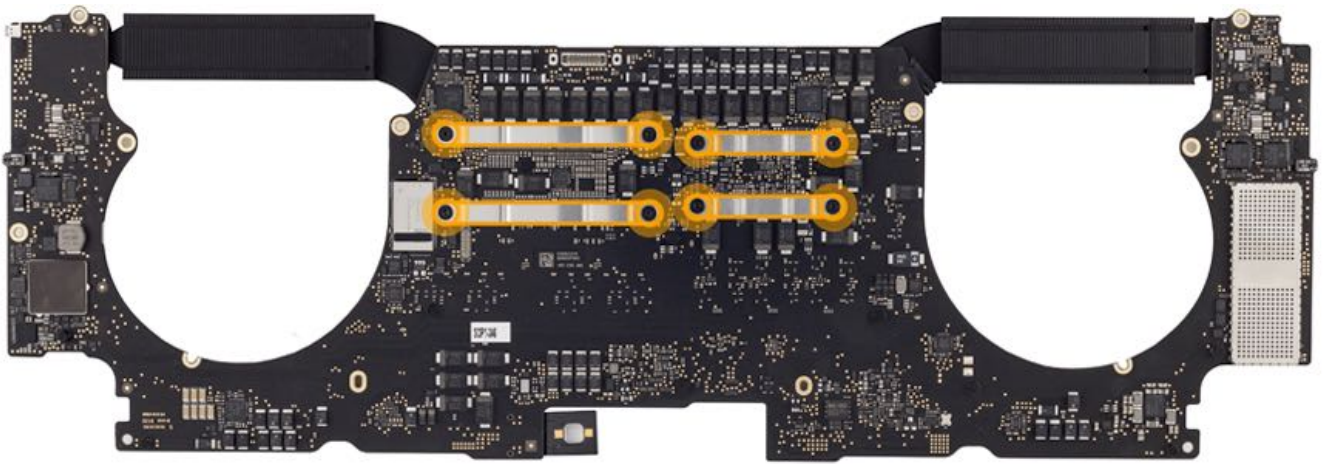
2. Carefully align the heat sink screw bosses with the screw holes on the logic board. Hold the heat sink in place as you carefully turn over the logic board to reinstall the screws.



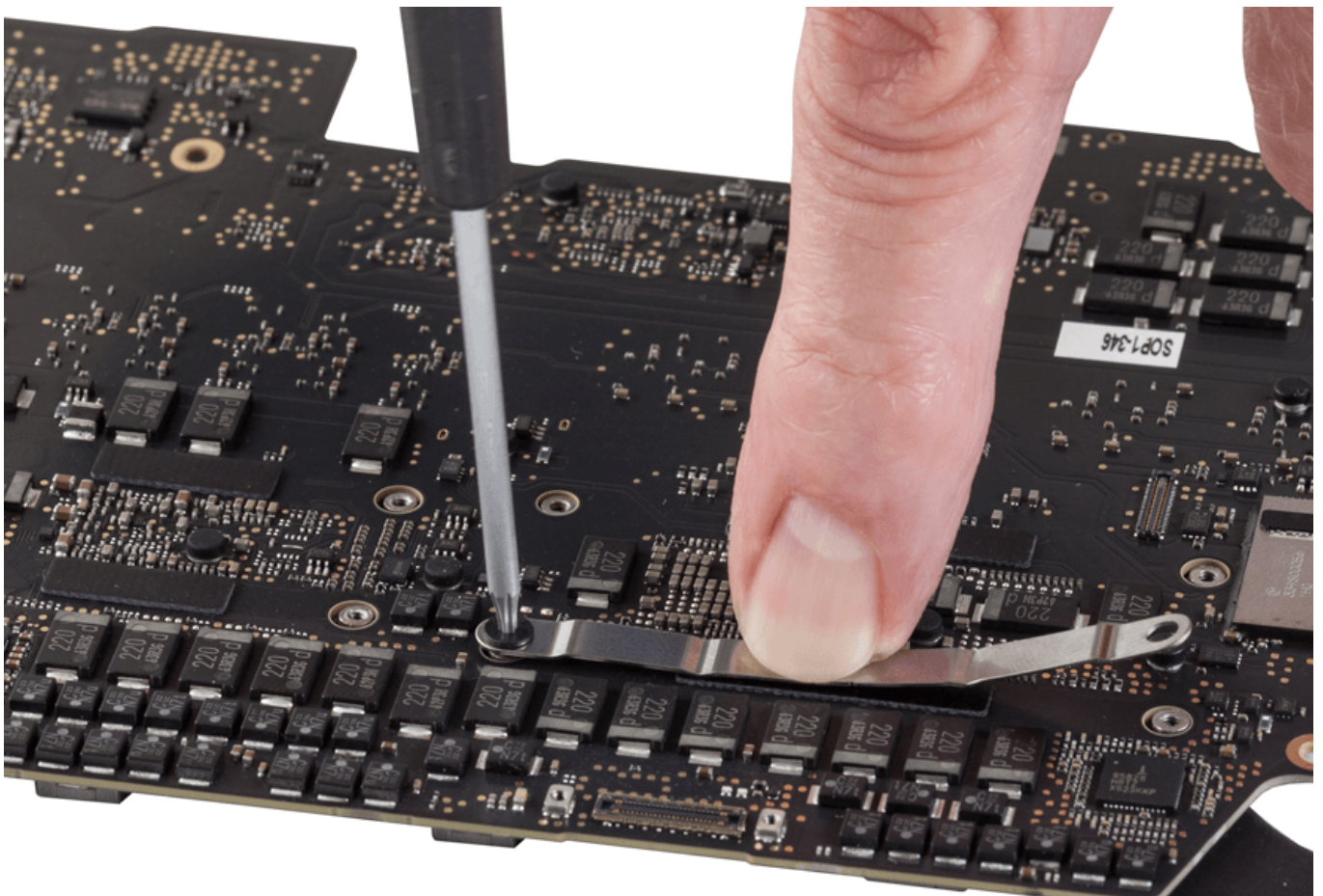
3. Reinstall the heat sink flexures and eight T5 heat sink screws.

Note:

- There are two sizes of flexures. Be sure to reinstall in the correct location.



- The heat sink flexures are under tension. Gently hold down the flexure when replacing the second screw on each flexure clip.



4. Reinstall the [logic board](#).
5. Reinstall the [clutch covers](#).
6. Reconnect the [battery](#) and remove the battery cover.
7. Reinstall the [bottom case](#).
8. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
9. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Embedded DisplayPort (eDP) Flex Cable

First Steps



Warning:

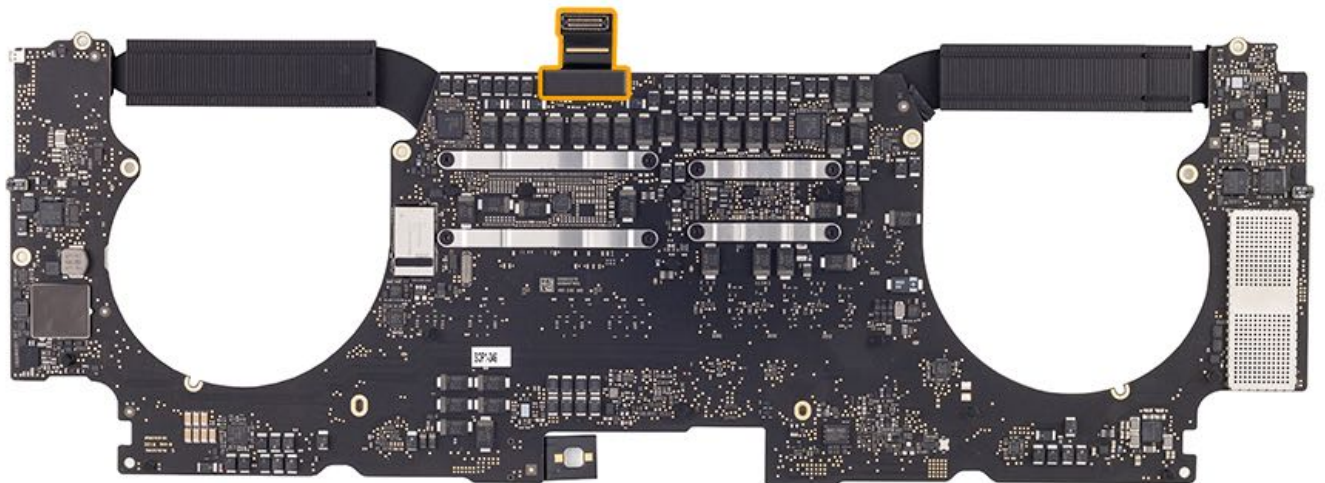
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)
- [Logic board](#)



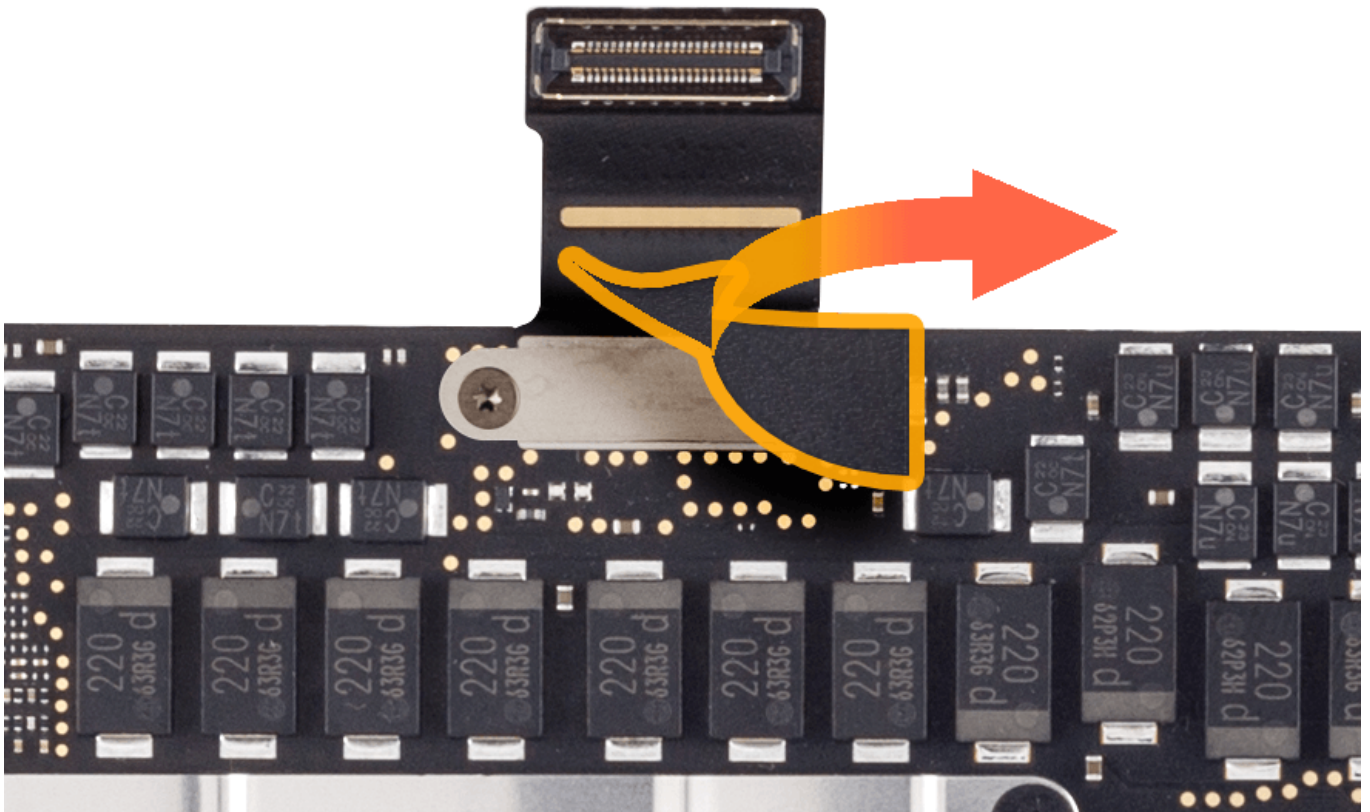
Tools

- Torx T3 screwdriver
- Black stick
- ESD strap
- Protective battery cover (923-01320)



Steps For Removal

1. Turn the logic board over.
2. Remove the Mylar covering the eDP flex cable connector.



3. Remove two T3 screws from the eDP flex cable cowling.

- T3: 923-01190



4. With a black stick disconnect the eDP flex cable from the logic board.

Steps For Reassembly

1. Reassemble in reverse order of removal steps.
2. Be sure to replace the Mylar that was peeled off with new Mylar that is included with the part.
3. Reinstall the [logic board](#).
4. Reinstall the [clutch covers](#).
5. Reconnect the [battery](#) and remove the battery cover.
6. Reinstall the [bottom case](#).

7. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
8. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Vent/Antenna Assembly

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

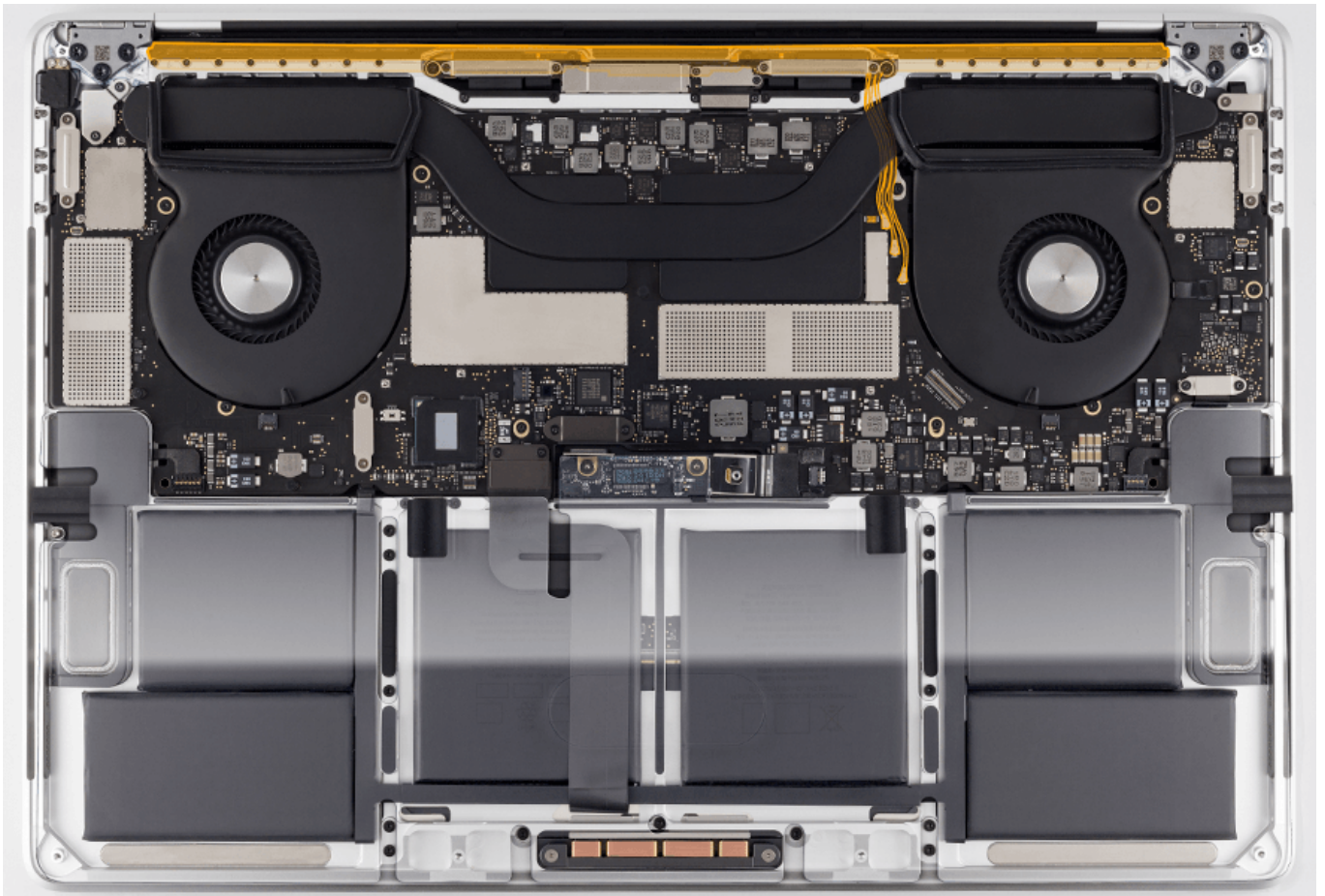
Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)

For video instruction, refer to article [SV309: Vent/Antenna Module Replacement Video](#).

To get a better idea of what you are removing/replacing, the Vent/antenna module looks like this:





Tools

- Antenna tool, optional, (923-01322)
- Black stick
- Torx T5 screwdriver (magnetized)
- Torque driver (blue), 0.65kgf-cm (923-0448)
- Torx security bit (923-0247)
- ESD-safe plastic or nylon tweezers
- ESD wrist strap
- Protective battery cover (923-01320)



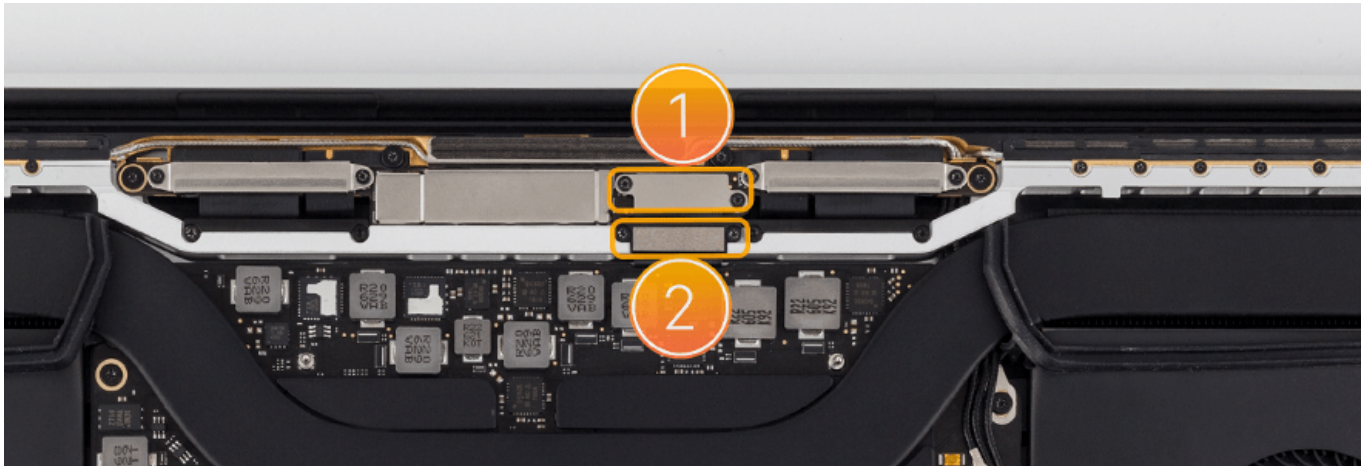
Steps For Removal

1. Remove the two T3 screws on the upper Embedded DisplayPort (eDP) flex cable cowling (1) and the two T3 screws from the lower eDP flex cable cowling (2) and disconnect.

- T3: 923-01285 (upper)



- T3: 923-01510 (lower)



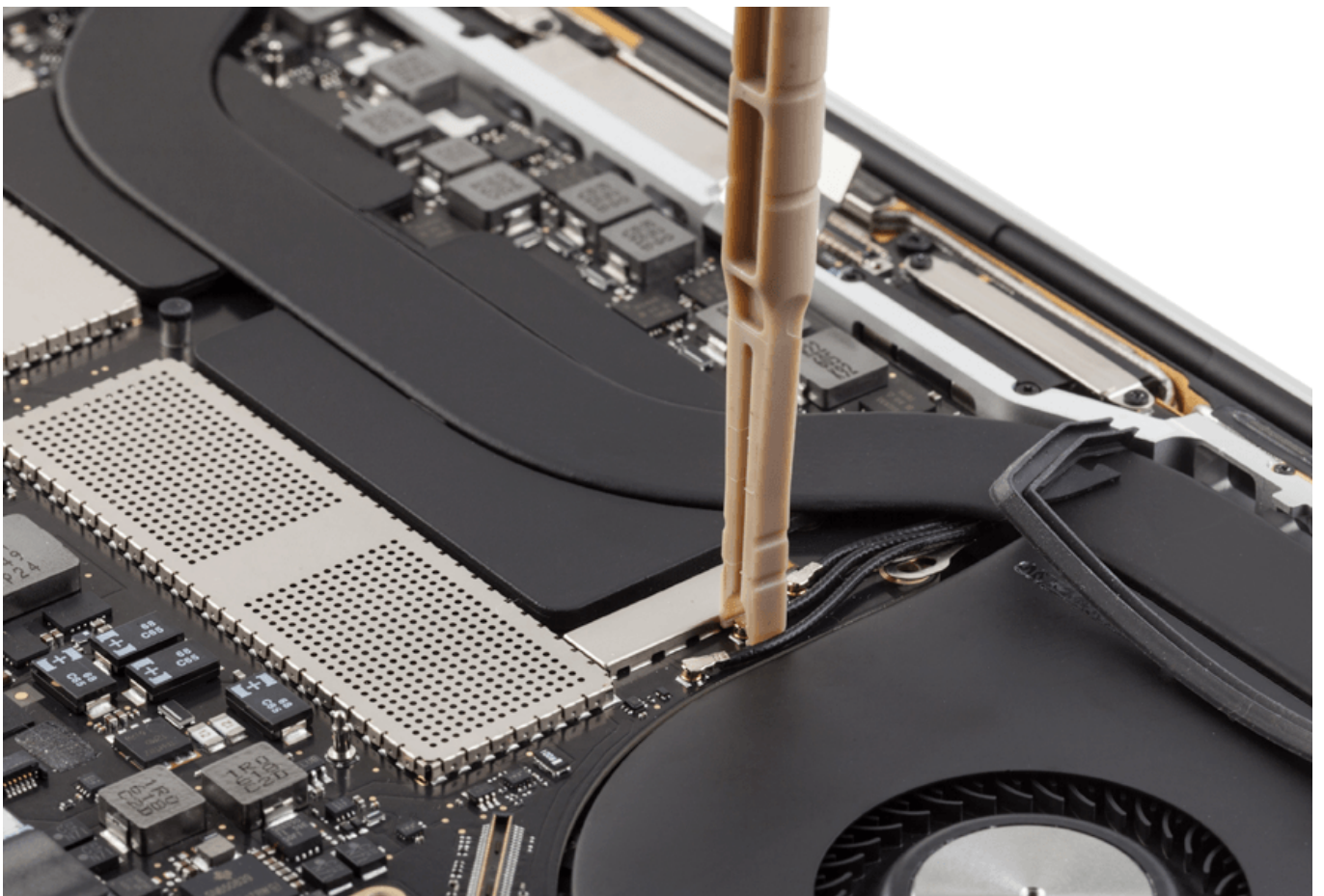
2. Remove the T5 antenna grounding screw from the logic board.

- T5: 923-01500





3. Using the antenna tool, disconnect the the antenna cables from the logic board.

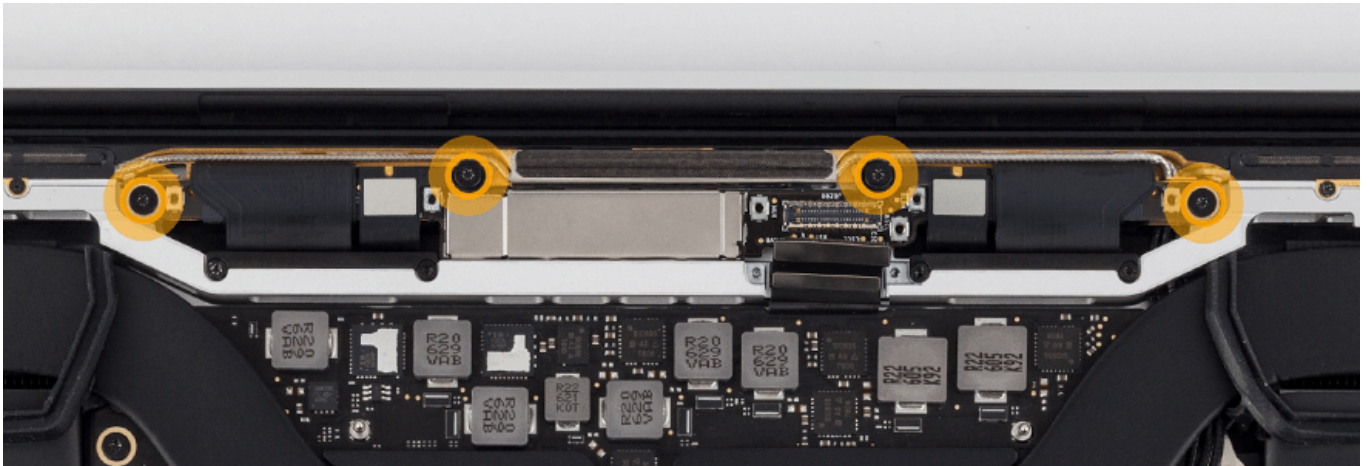


4. Remove the four T5 TCON screws.

- T5: 923-01277

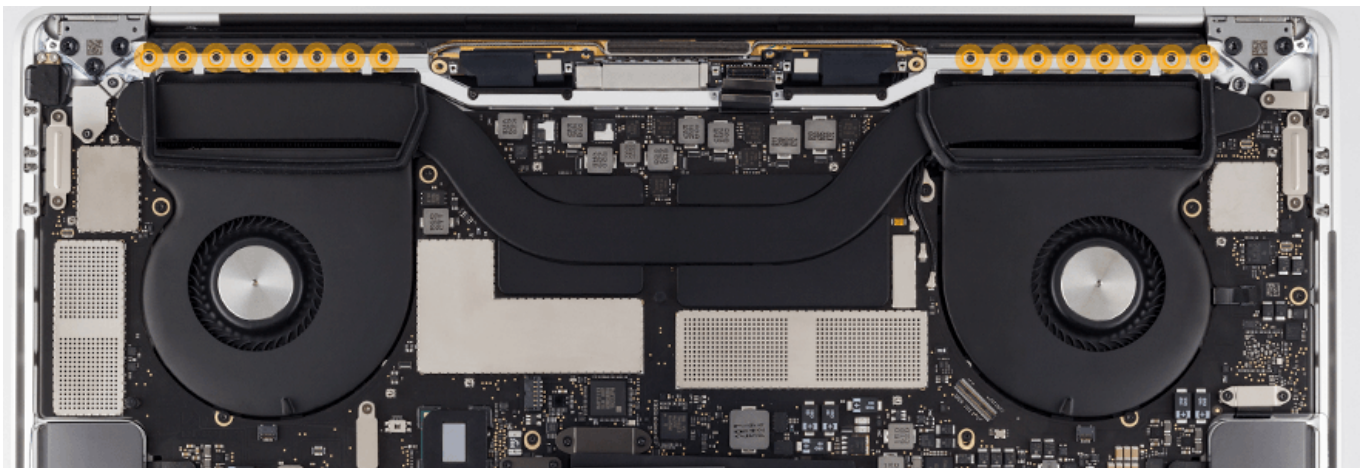


Note: The TCON board is part of the display assembly. Once the four TCON screws are removed, the TCON will release and the Vent/antenna module can be accessed.



5. Remove the 16 1IPR Vent/antenna screws with the torque driver and Torx security bit. **Note:** Use a magnetized driver to remove and reinstall the very small screws.

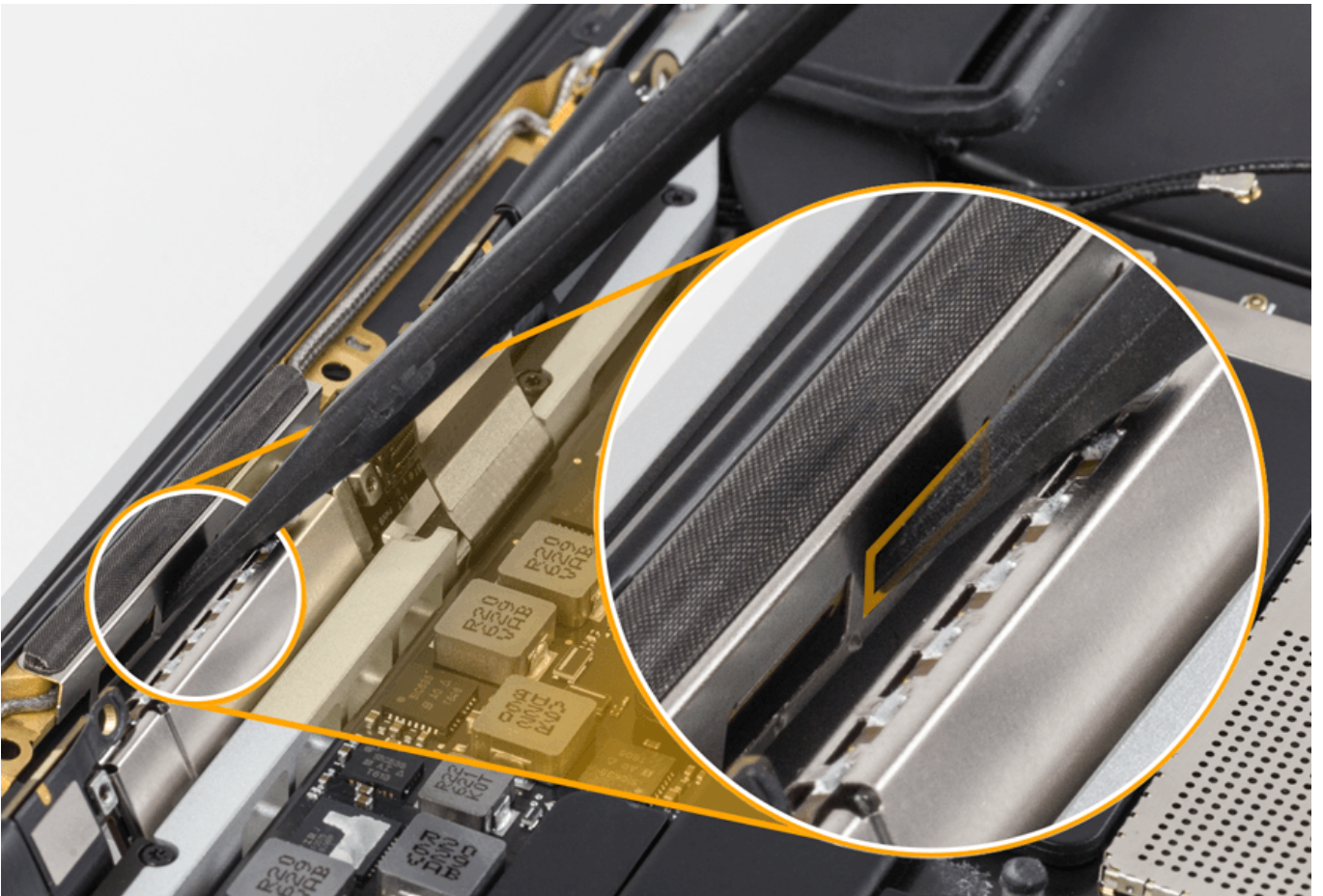
- 1IPR: 923-01512



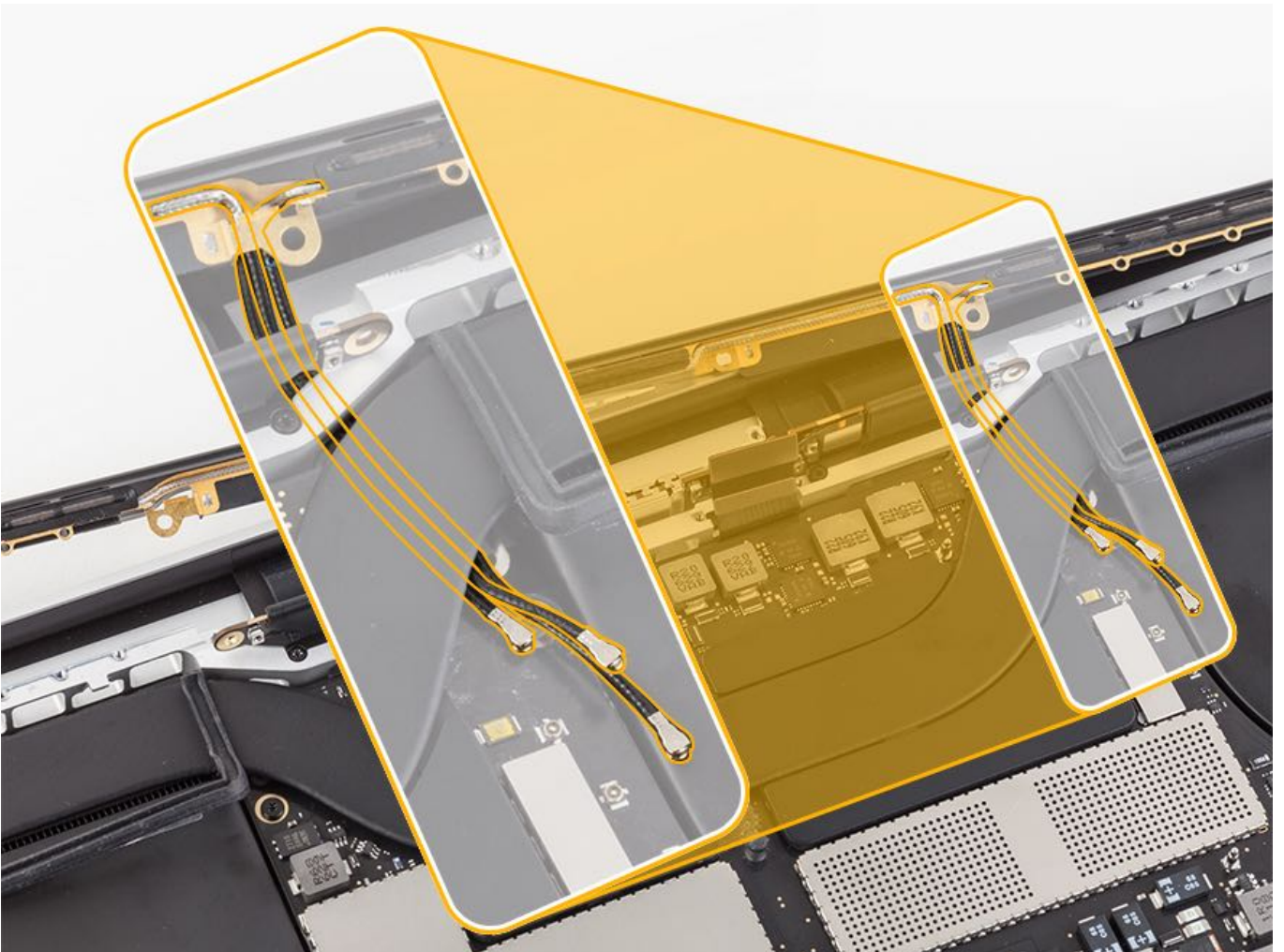
6. Find the middle slot in the Vent/antenna module and gently insert the pointed end of a black stick in the slot to raise the Vent/antenna module out of the top case. You will hear a slight click when the Vent/antenna module has released.

Caution:

- Be careful not to put pressure on the eDP flex cable.
- Support the Vent/antenna module with your other hand to prevent it from bending as you take it out of the top case.



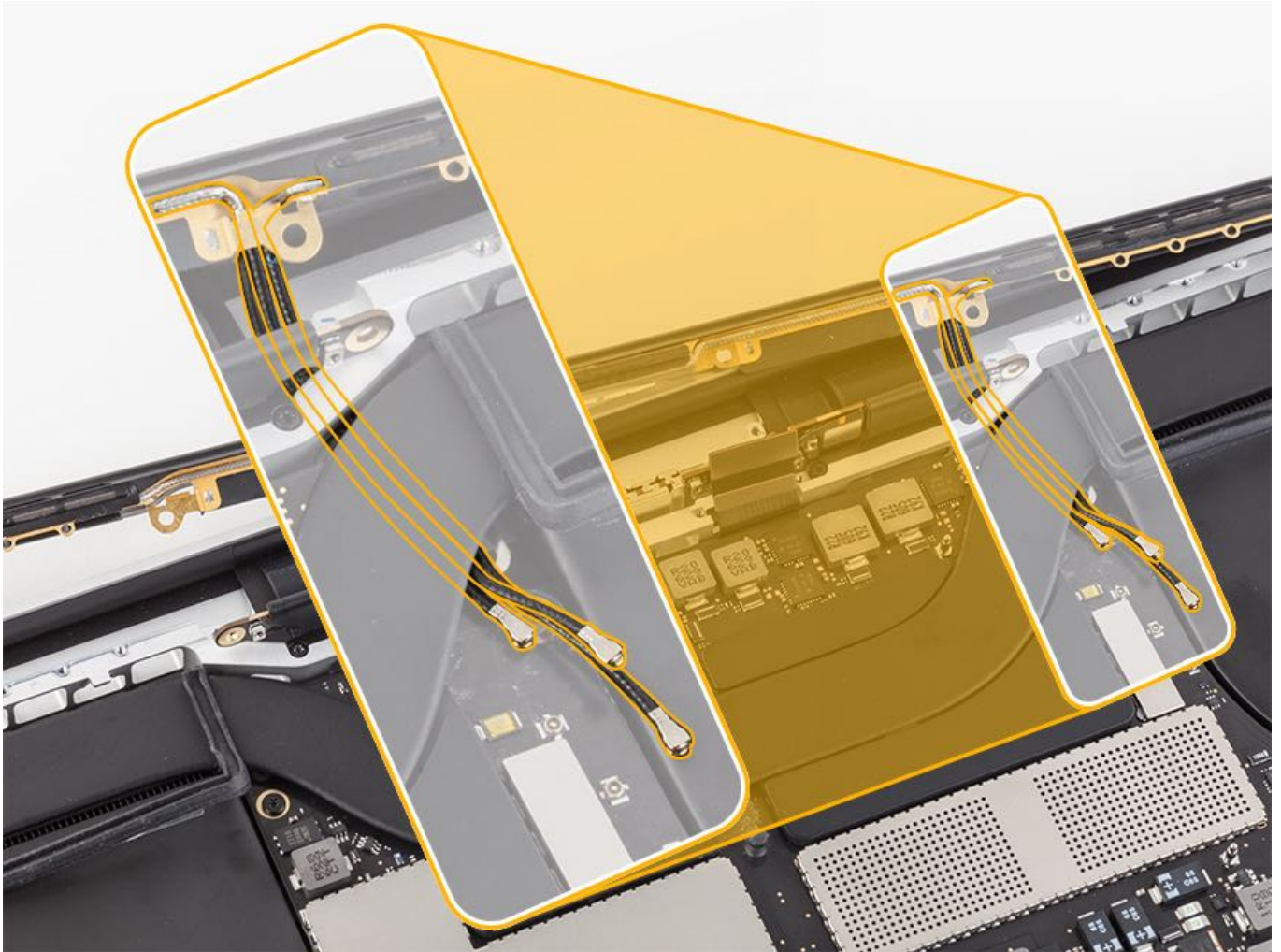
7. Route the antenna ground clip and three antennas through the opening in the rear wall. Be careful not to damage the wireless cables.



Steps For Reassembly

1. Use tweezers and/or black stick to route the three antennas and ground clip through the opening in the rear wall and over the logic board. Make sure the three cables are side-by-side, not overlapping.

Note: Some replacement Vent/antenna modules include a removable sleeve to protect the antenna cables during shipment. You can keep the sleeve on the cables when rerouting them into the top case. However, remove the sleeve when the cables are positioned over the logic board.



2. Align the Vent/antenna module in the top case and gently press down in the middle of the module until you hear a slight click.

3. Reconnect the antennas and reinstall the T5 antenna ground screw (923-01500).

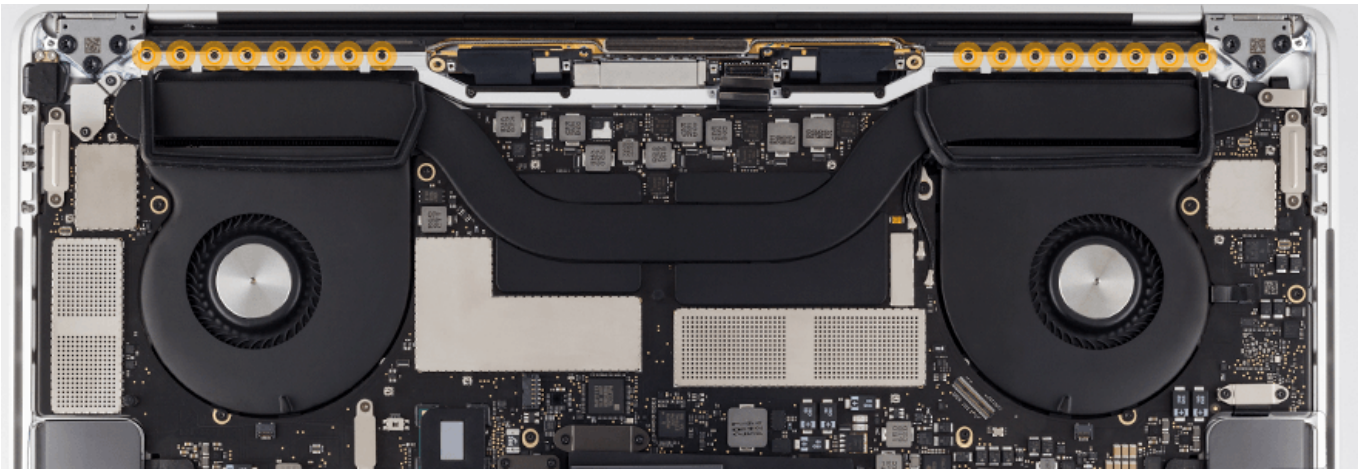
Note: When reconnecting the antennas, use tweezers to align the antenna head with the connector on the logic board. Then use the flip side of the antenna removal tool to make the connection.



4. Reinstall the 16 1IPR Vent/antenna screws (923-01512) with the torque driver and Torx security bit.

Note: Use a magnetized driver to remove and reinstall the very small screws.

Note: Turn each screw until the torque driver clicks (applies the correct torque). Some screws may seat properly without an audible click. Do not over tighten the screws.



5. Then reassemble in reverse order of removal steps.
6. Reinstall the [clutch covers](#).
7. Reconnect the [battery](#) and remove the battery cover.
8. Reinstall the [bottom case](#).
9. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
10. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Fans

First Steps



Warning:

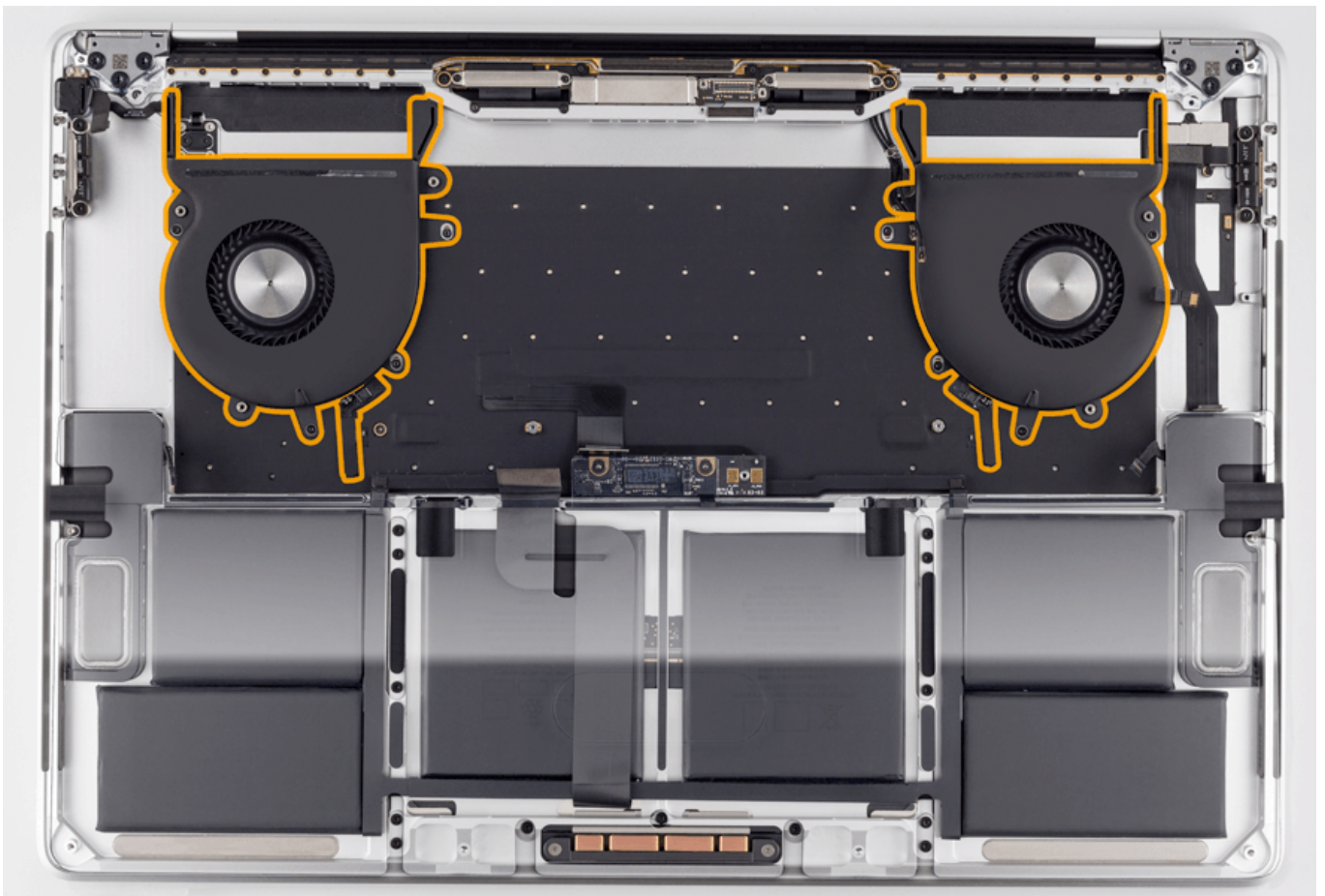
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)
- [Logic board](#)



Note: The left and right fans can be replaced separately. They do not have to be replaced as a pair, however, the procedure is the same for both.

Tools

- Torx T3 screwdriver (magnetized)
- Black stick
- ESD wrist strap
- Protective battery cover (923-01320)



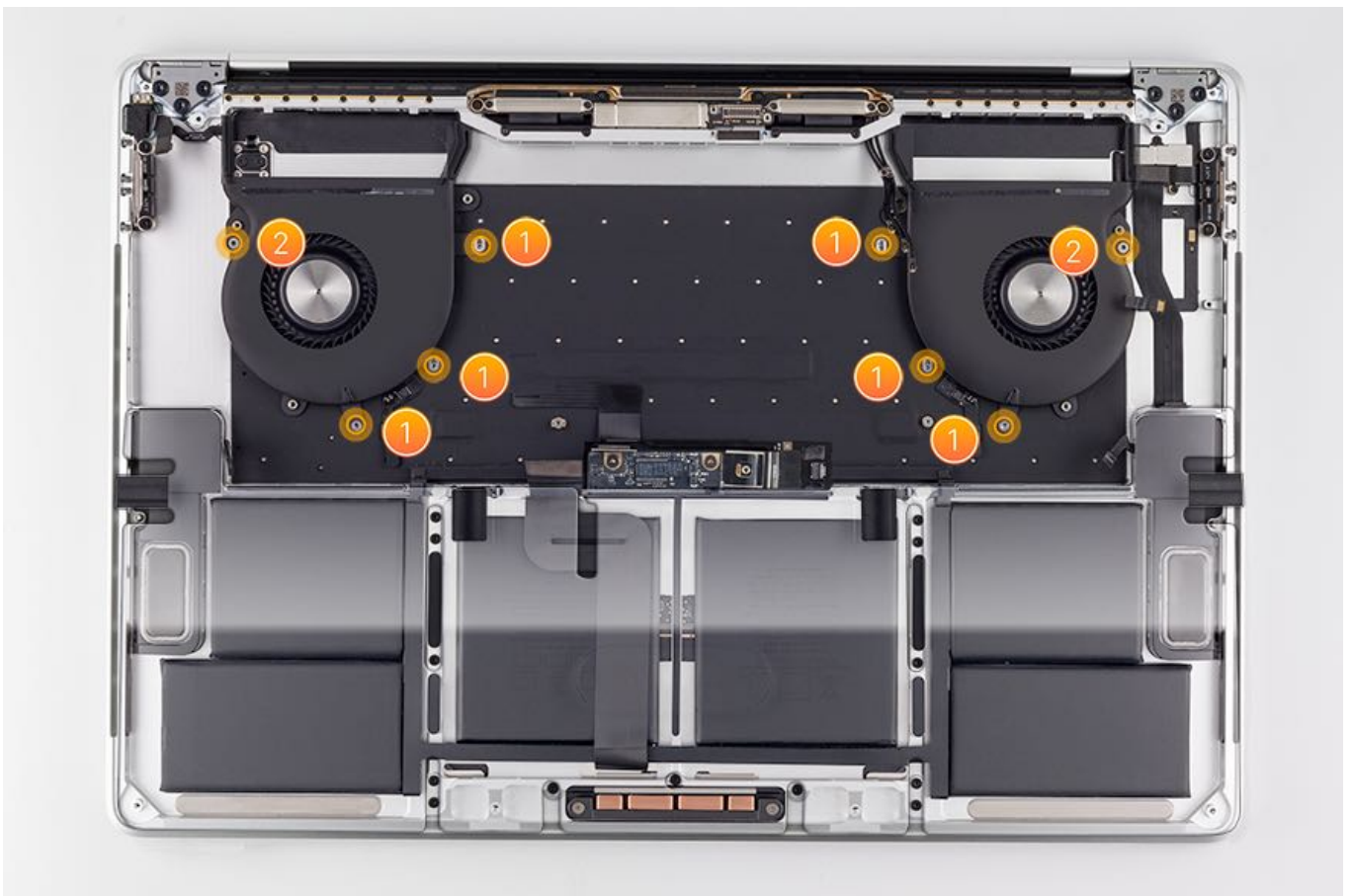
Steps For Removal

1. If removing one fan, remove three black T3 fan screws (1) and one silver T3 (2) screw. If removing both fans, remove six black T3 fan screws (1) and two silver T3 (2) screws.

- T3: 923-01423 (position 1)



- T3: 923-01515 (position 2)



2. Peel back the Mylar covering the fan flex cable.



3. Lift the locking lever and using tweezers, carefully disconnect the flex cable.



Steps For Reassembly

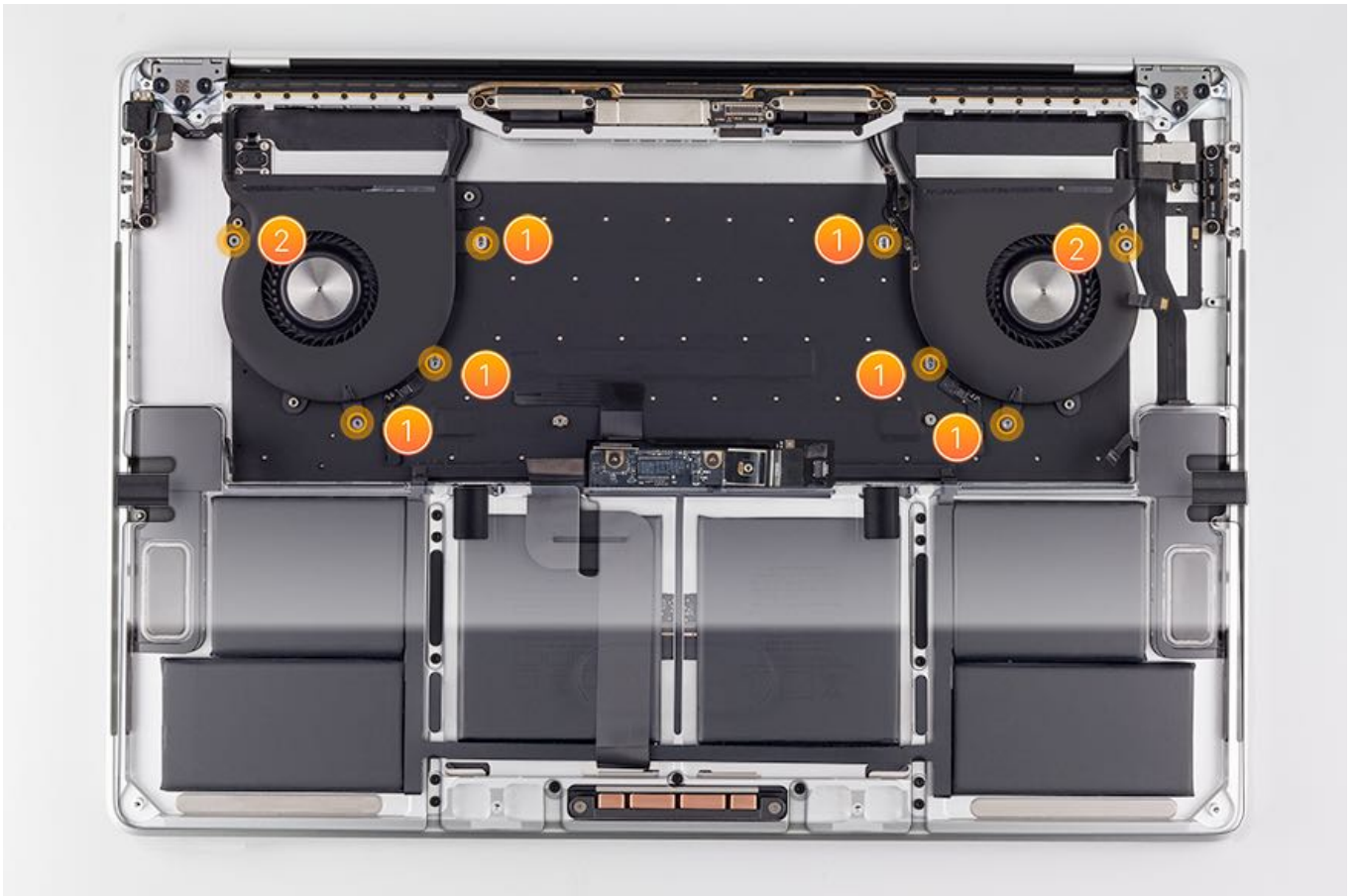
1. Lay the fan back into the top case, reconnect the flex cable and tape down the Mylar.

2. Carefully align the screw holes and the screw bosses. **Note:** It may help to torque screws halfway first to make sure all four screws are aligned correctly, then go back and tighten screws.

- T3: 923-01423 (position 1)



- T3: 923-01515 (position 2)



3. Reinstall the [logic board](#).
4. Reinstall the [clutch covers](#).
5. Reconnect the [battery](#) and remove the battery cover.
6. Reinstall the [bottom case](#).
7. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
8. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Input/Output (I/O) Boards

First Steps



Warning:

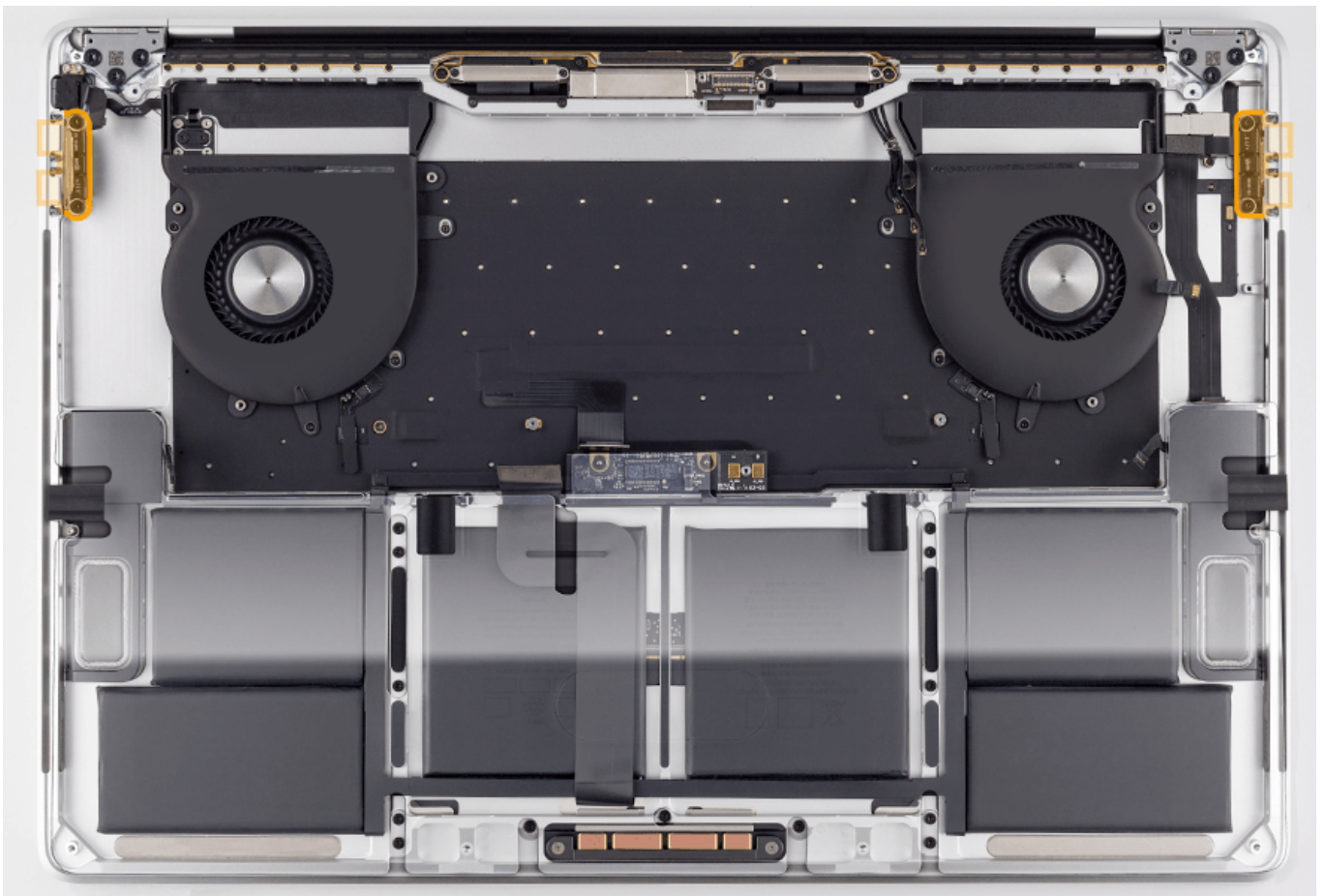
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)
- [Logic board](#)



Tools

- Black stick
- Torx T5 screwdriver (magnetized)
- ESD wrist strap
- Protective battery cover (923-01320)



Steps For Removal

1. Remove two T5 screws.

- T5: 923-01509

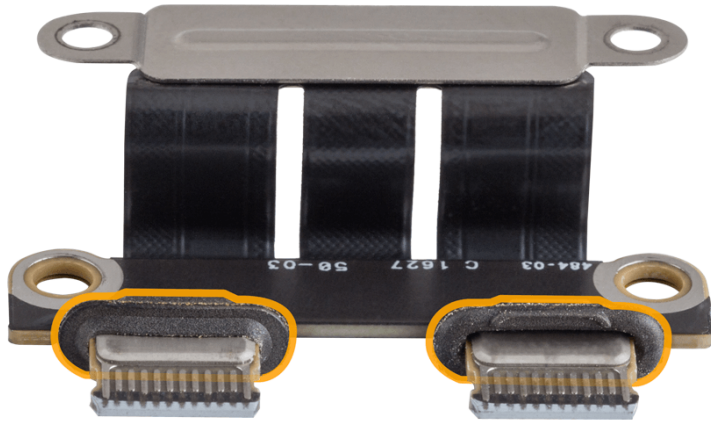


2. Grasp the board by the sides and gently slide out of the ports.

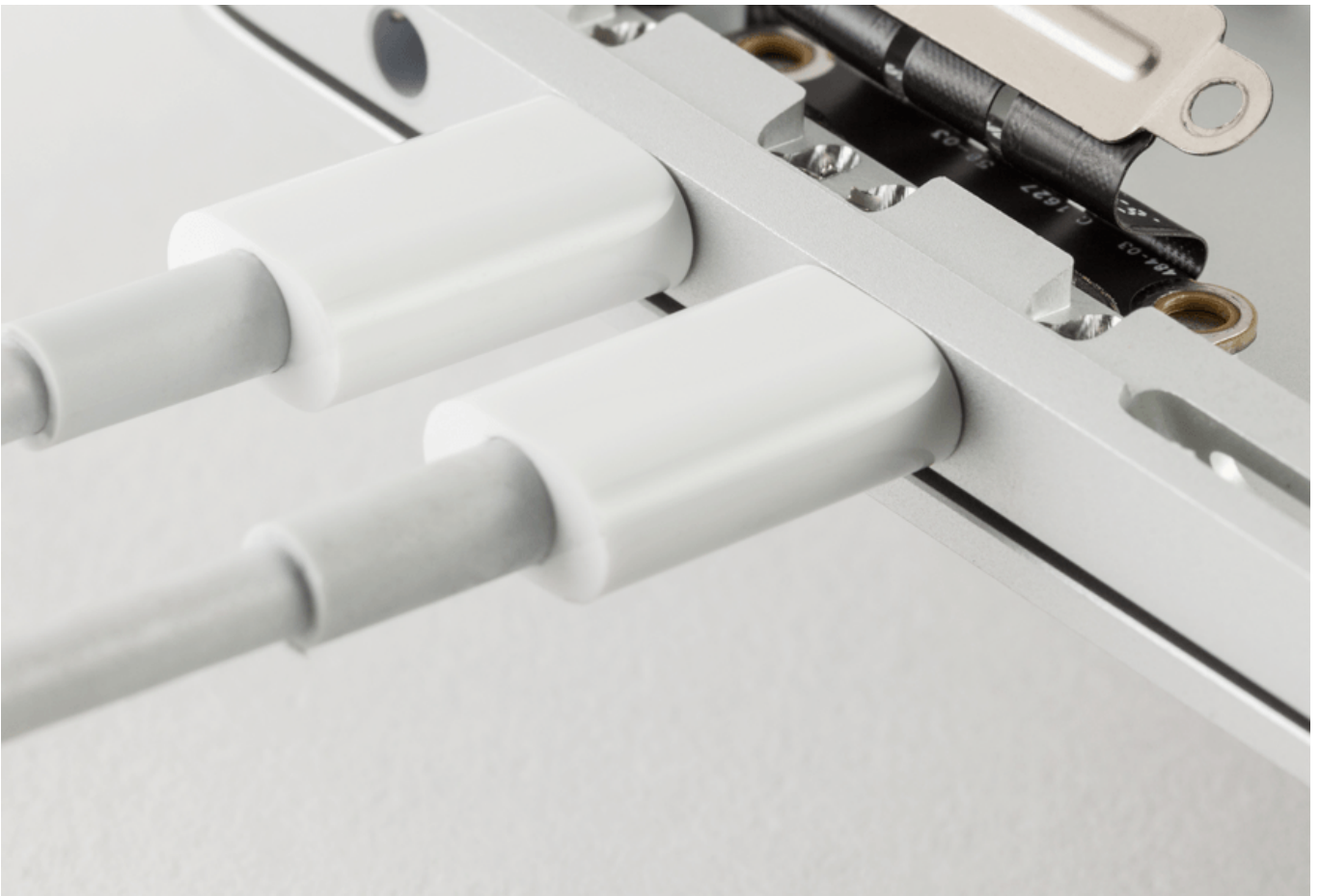


Steps For Reassembly

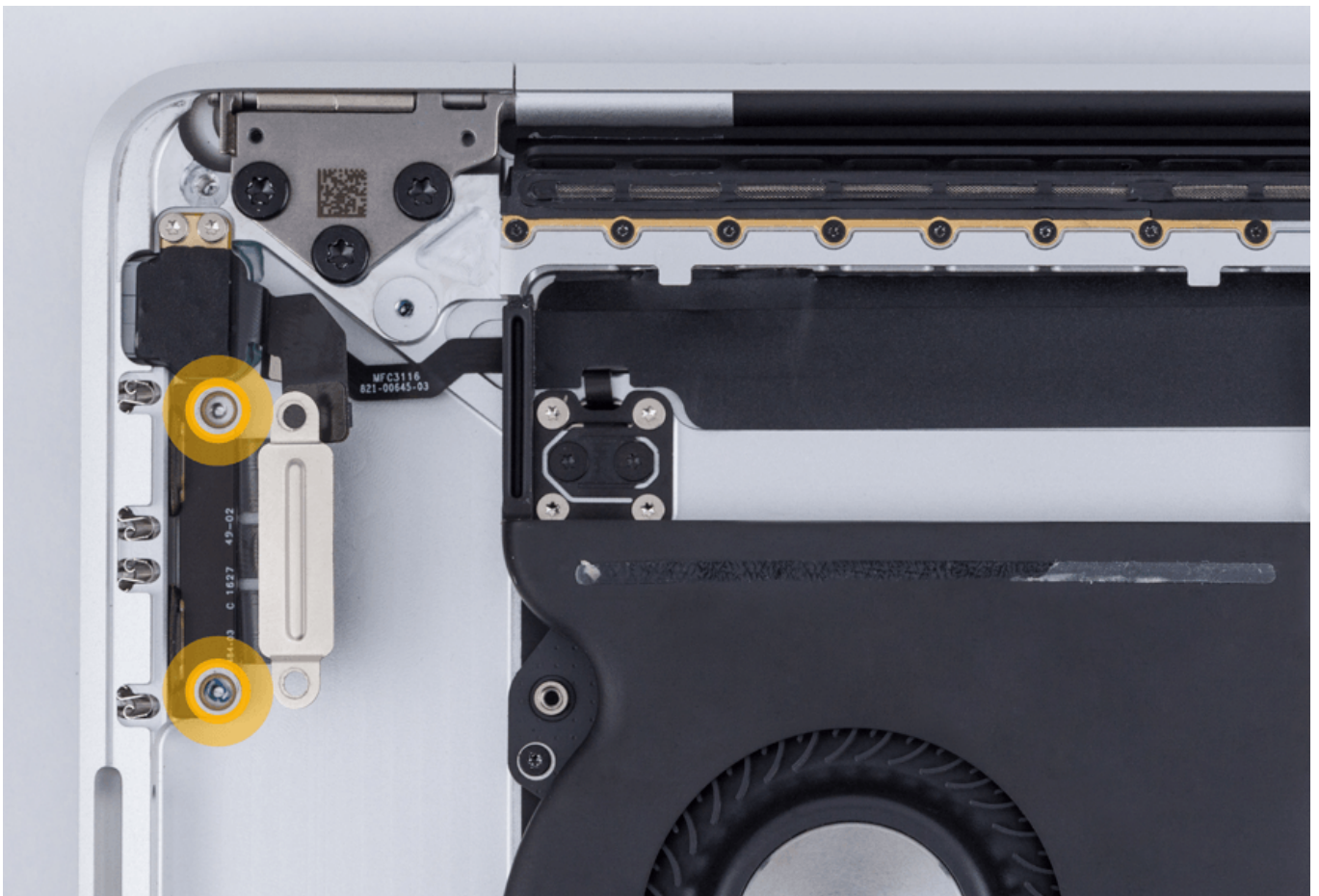
Note: Before reinstalling the left or right I/O board, check to make sure the rubber gaskets are not damaged and are intact. If not, the I/O board will need to be replaced.



1. After placing the board into position in the top case, plug in an external USB-C charge cable to both Thunderbolt 3 ports.
Warning: The charge cable should NOT be plugged into power.



2. Keeping the cable connected, check that the screw holes in the board align with the screw bosses in the top case.



3. Reinstall the [logic board](#).
4. Reinstall the [clutch covers](#).
5. Reconnect the [battery](#) and remove the battery cover.
6. Reinstall the [bottom case](#).
7. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
8. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Display Assembly

First Steps



Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)
- [Vent/antenna module](#)

For video instruction, refer to article [SV310: Display Assembly Replacement Video](#).



Tools

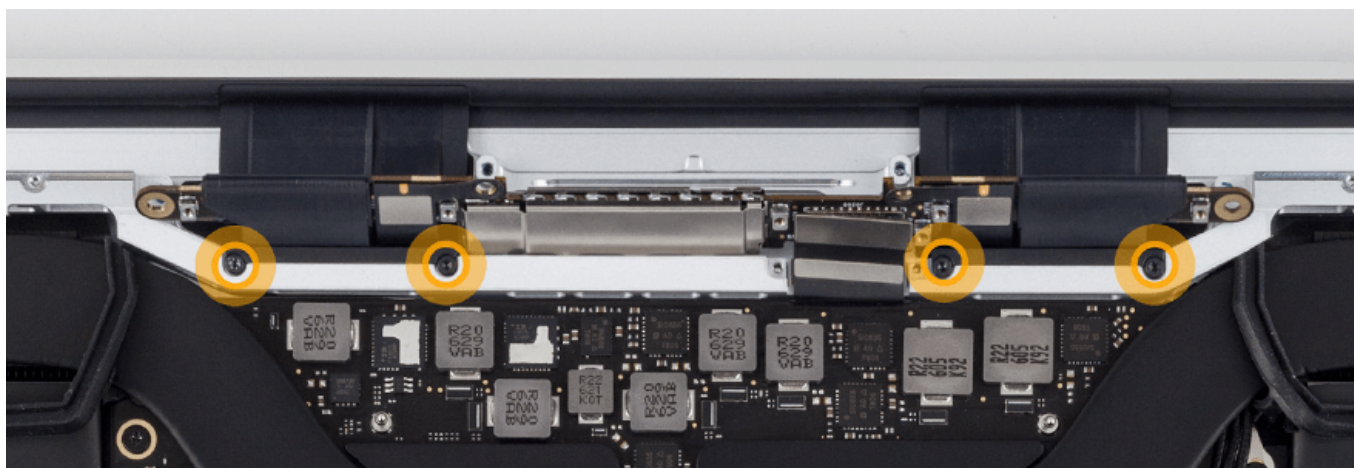
- Torx T3 screwdriver
- Torx T8 screwdriver
- ESD wrist strap
- Battery cover (923-01320)



Steps For Removal

1. Remove four T3 spring tensioner screws secured to the rear wall.

- T3: 923-01185



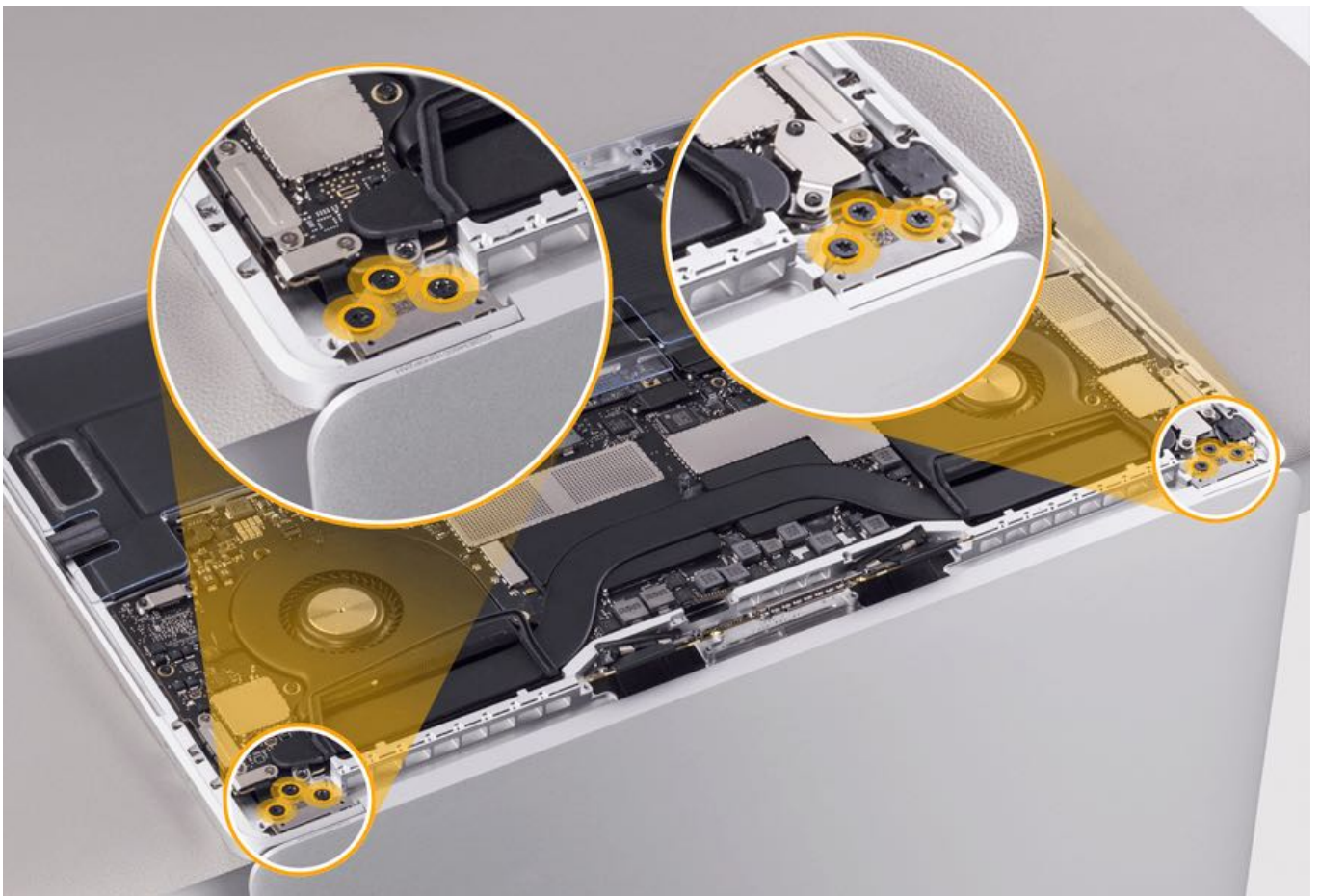
2. Open the display and place the computer on the edge of a workbench, with the display hanging down.



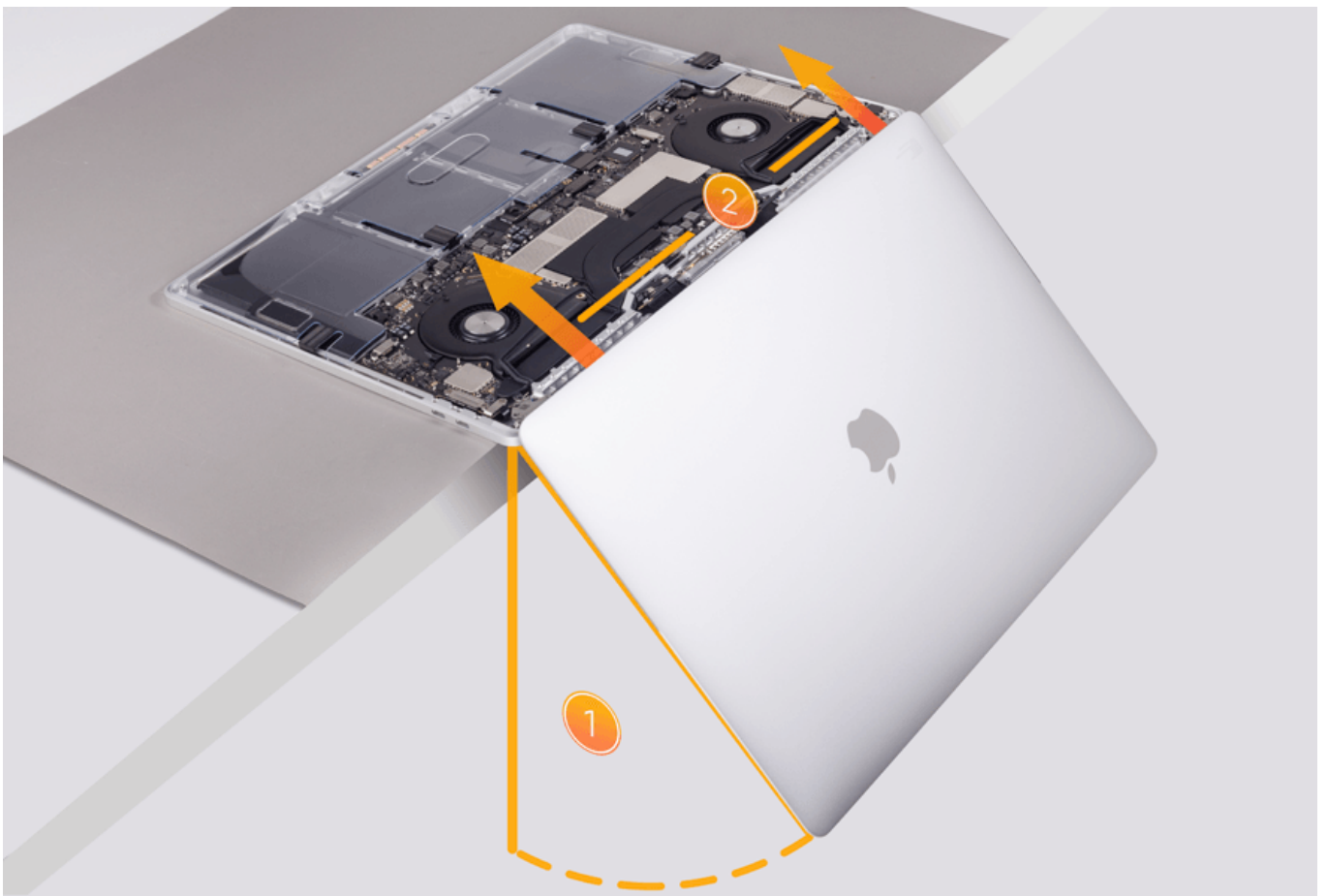
3. Remove six T8 display hinge screws.

- T8: 923-01173





4. Separate the display assembly from the top case. Pull the display toward you about 15 degrees (1), then lift the display up and off the top case (2).



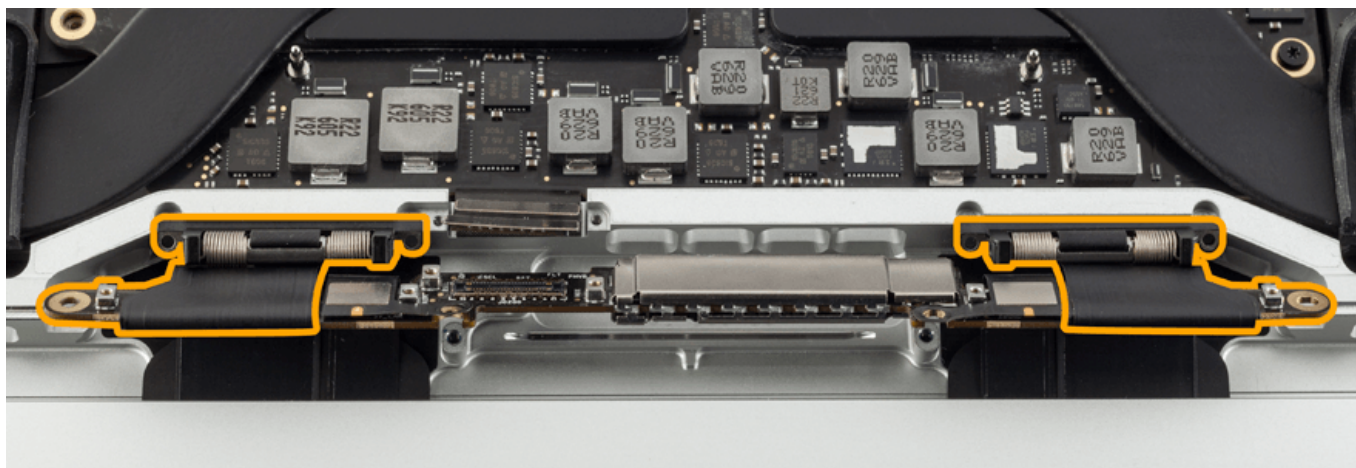
Steps For Reassembly

Note: The display assembly module includes the TCON Board and the spring tensioners. When reinstalling the display

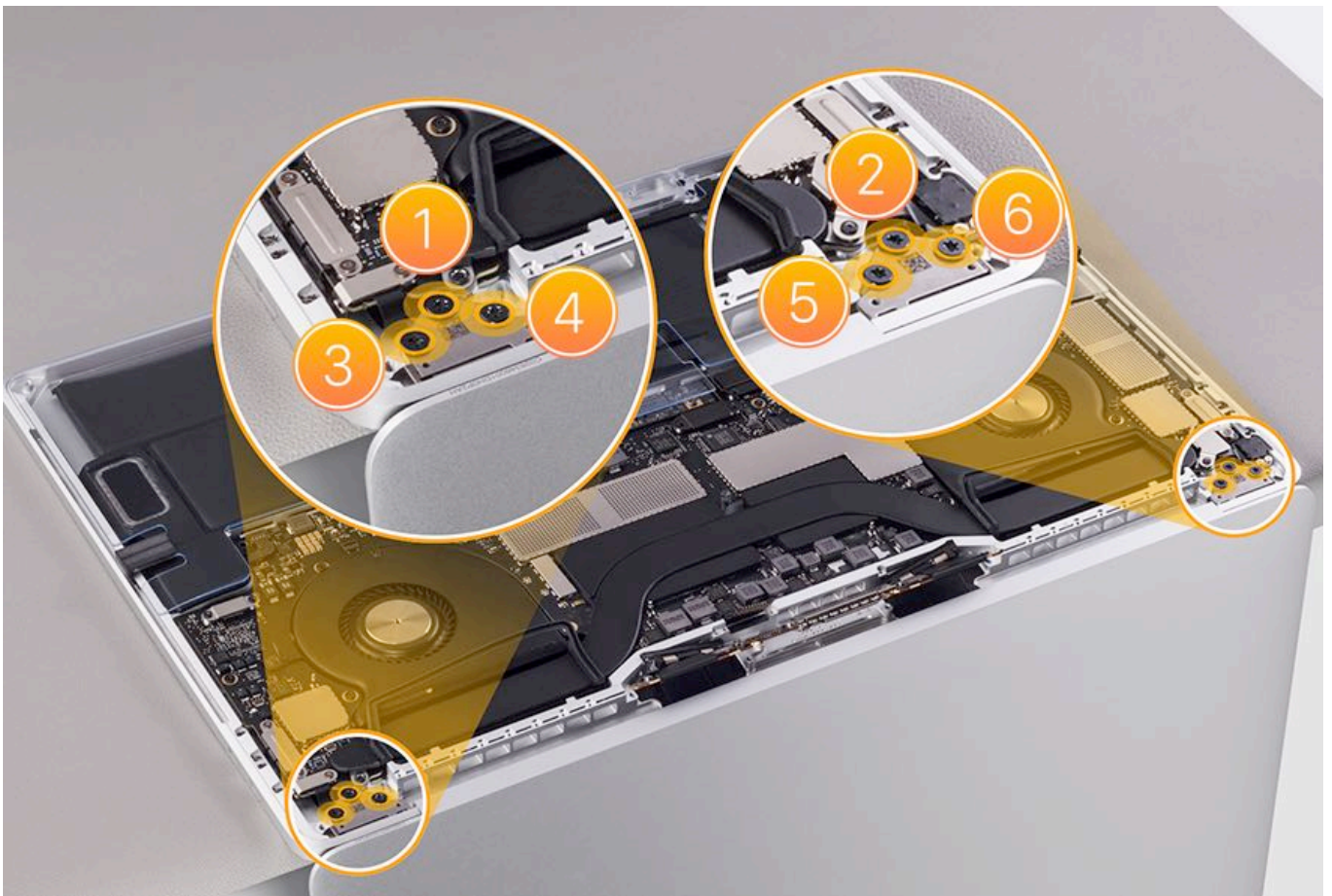
assembly, be sure the module does not get crimped or caught on the outside of the display.



1. Reinstall the display onto the top case. Make sure that the TCON board and spring tensioner cables are positioned within the top case. If reassembled incorrectly, the display assembly module could get wedged between the hinge and display.



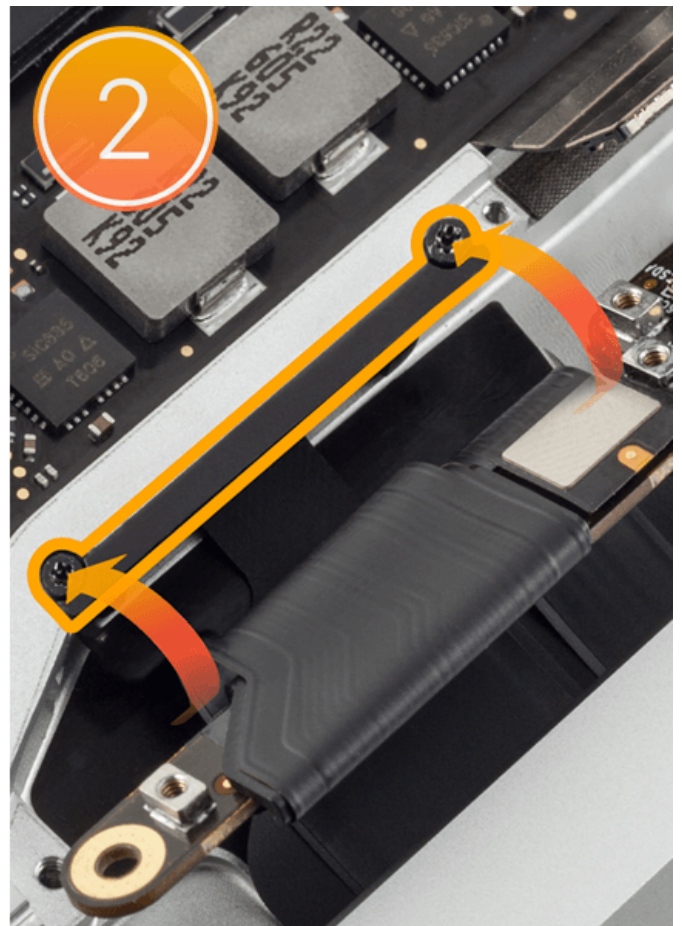
2. Loosely reinstall the six T8 display hinge screws (923-01173) in the order shown.



3. Close the top case and check the display alignment. Adjust as necessary until the top case and bottom case are aligned.

4. Tighten all six T8 screws.

5. Roll the spring tensioner forward and align the screw holes on the spring tensioners with the screw holes on the rear wall. Reinstall the T3 screws (923-01185).



6. Reinstall the [clutch covers](#).
7. Reconnect the [battery](#) and remove the battery cover.
8. Reinstall the [bottom case](#).
9. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
10. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Keyboard Flex Cable

First Steps



Warning:

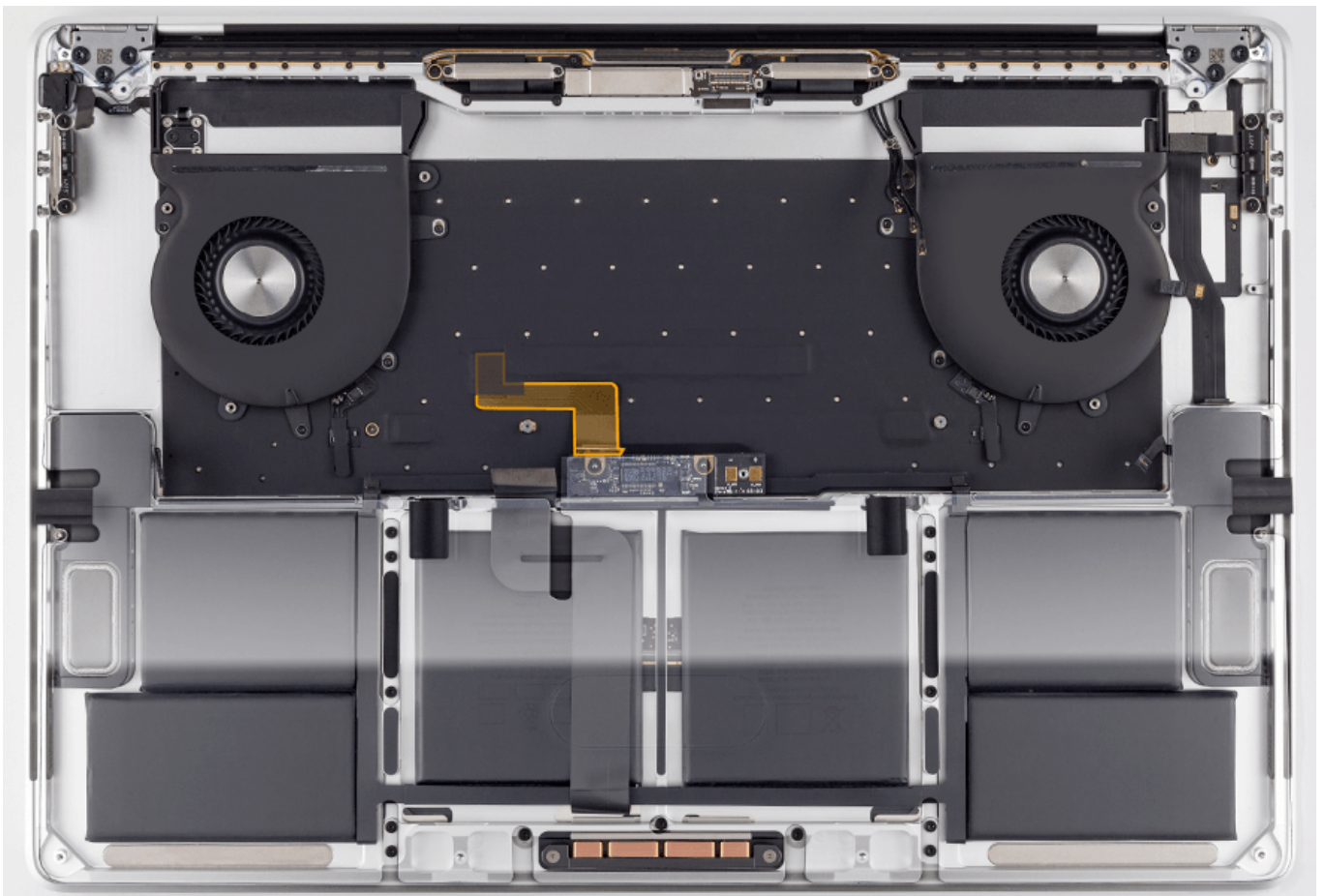
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)
- [Logic board](#)



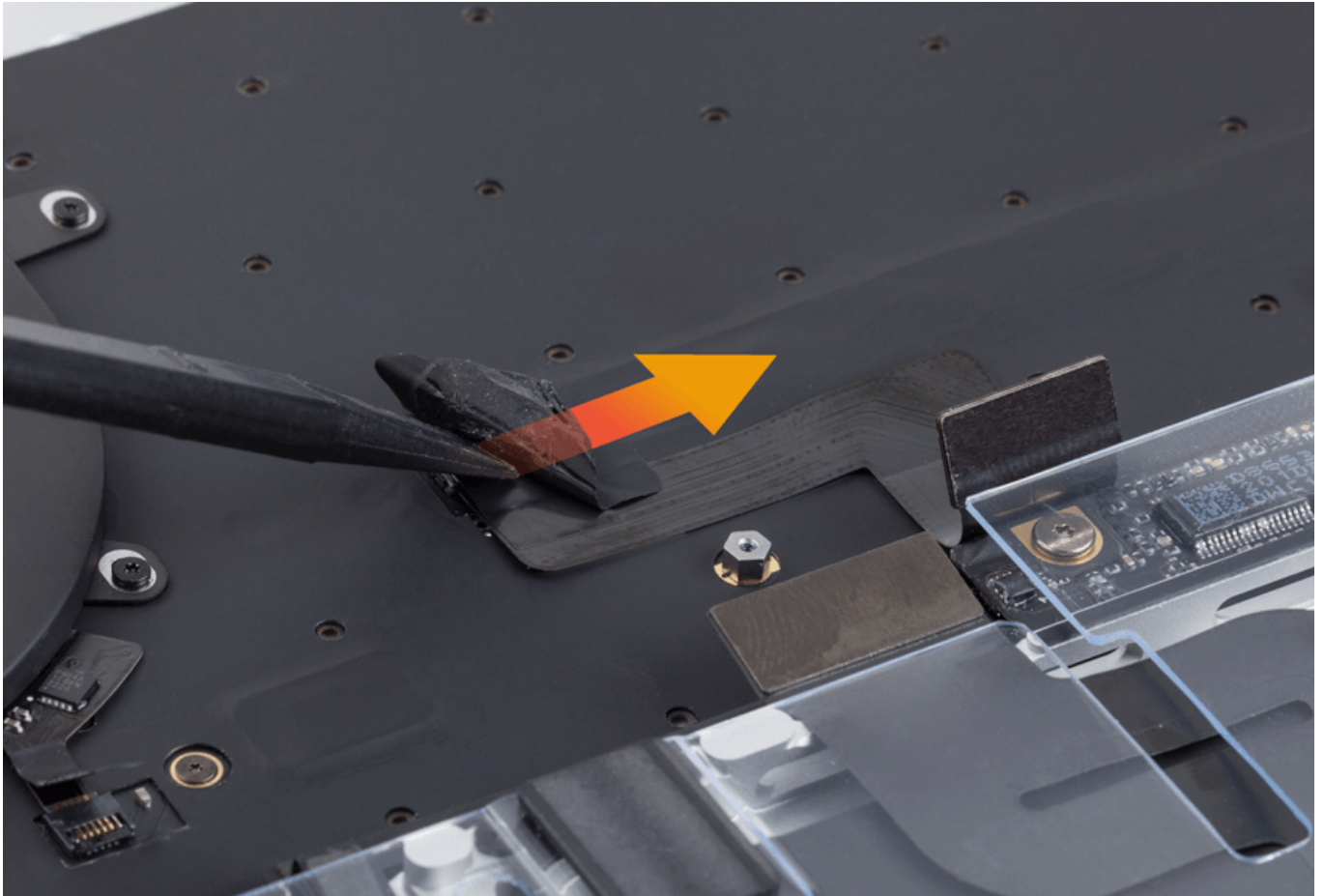
Tools

- Black stick
- ESD wrist strap
- Protective battery cover (923-01320)

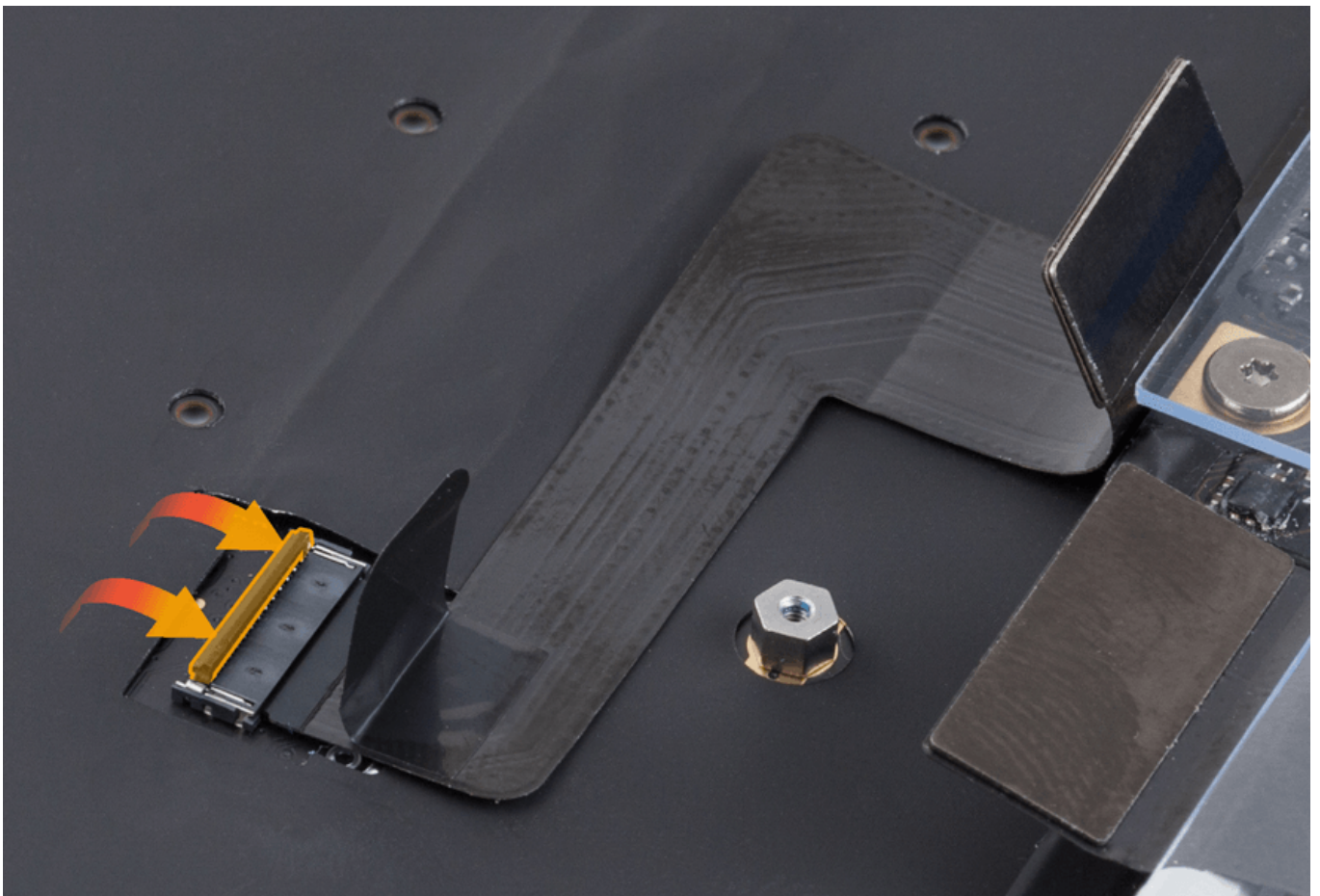


Steps For Removal

1. With the flat end of a black stick, remove the Mylar that is covering the keyboard flex cable.



2. Lift up the locking lever and remove the flex cable.



Steps For Reassembly

1. Reconnect the keyboard flex cable. Secure the locking levers, pressing them flat.
2. Install the new Mylar that is included with the replacement flex cable.
3. Reinstall the [logic board](#).
4. Reinstall the [clutch covers](#).
5. Reconnect the [battery](#) and remove the battery cover.
6. Reinstall the [bottom case](#).
7. Verify the trackpad performance after every repair. For instructions, refer to article [TP1314: Trackpad Calibration Check](#).
8. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Top Case Assembly with Battery

First Steps



Warning:

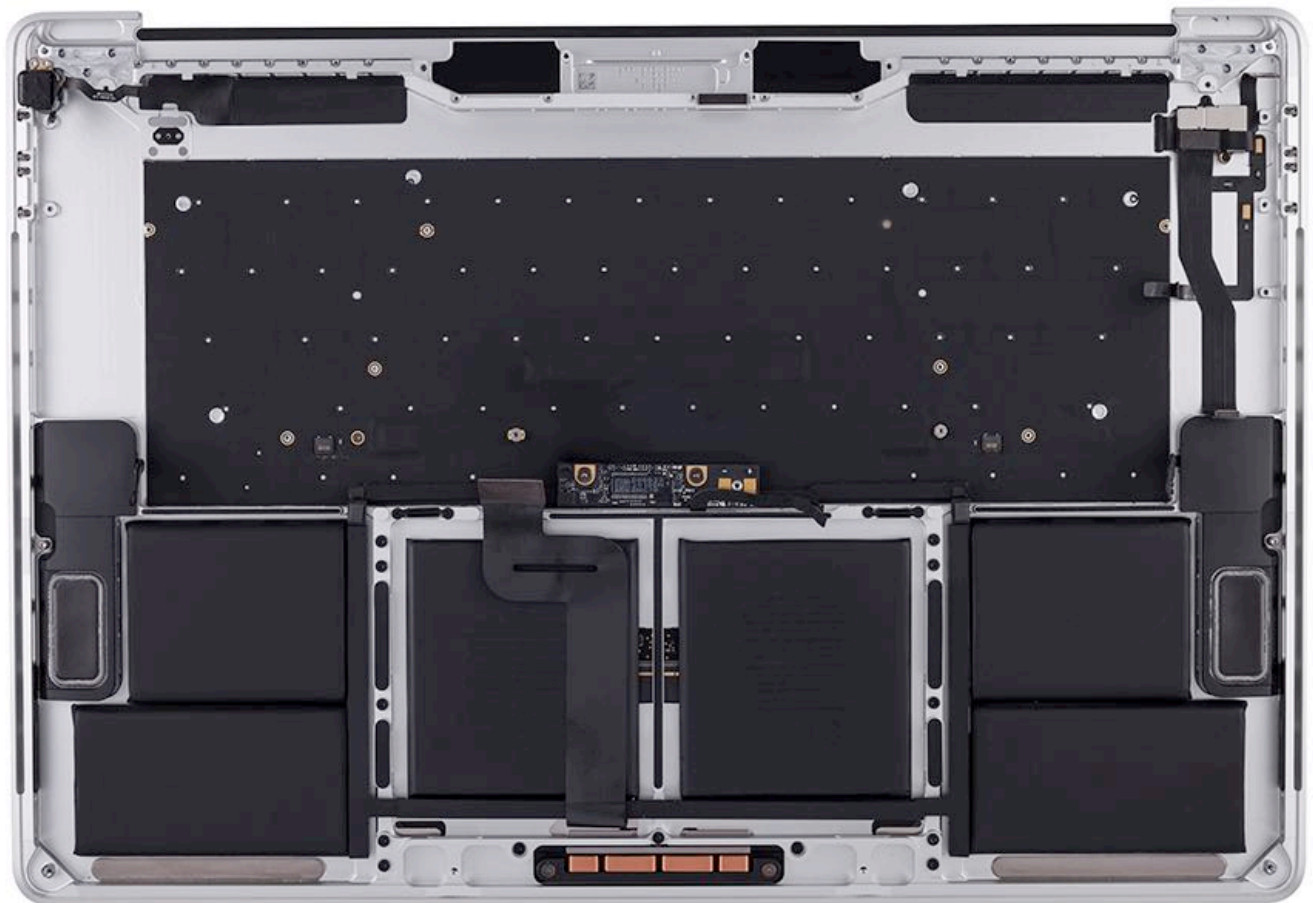
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article [HT205332: About AppleCare service certifications](#).
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Remove:

- [Bottom case](#)
- [Attach battery cover and disconnect battery](#)
- [Clutch covers](#)
- [Logic board](#)
- [Vent/antenna module](#)
- [Display assembly](#)
- [Fans](#)
- [I/O boards](#)
- [Touch ID](#)



Tools

- ESD wrist strap



Steps For Removal

With the first steps completed, the top case is the remaining component.

These components will also remain in the top case:

- Battery
- Keyboard
- Trackpad
- Microphone
- Trackpad flex cable
- Touch Bar flex cable
- Touch ID flex cable (**Note:** If flex cable is damaged, a replacement is included with the new top case.)
- Audio board
- Speakers
- Keyboard flex cable



Warning: The battery is part of the top case module. **Do not attempt to remove the battery from the top case.** For information on packaging a top case assembly with battery for return, see [TP1538: Battery Handling and Storage](#).

Steps For Reassembly

1. Reassemble in the following order:

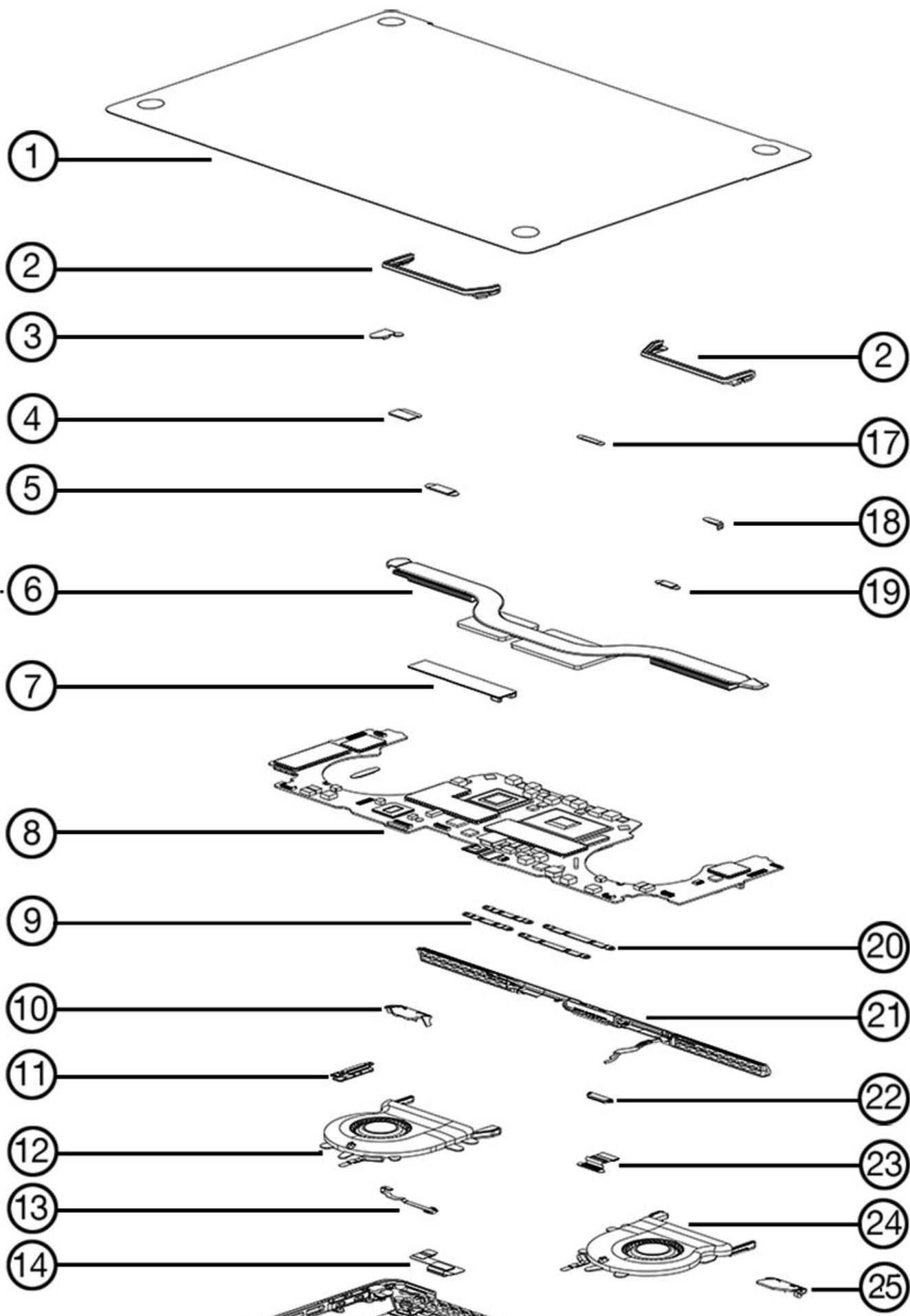
- [Display assembly](#)
- [Touch ID](#)
- [I/O boards](#)
- [Fans](#)
- [Vent/antenna module](#)
- [Logic board](#)
- [Clutch covers](#)
- [Remove battery cover and connect the battery](#)
- [Bottom case](#)

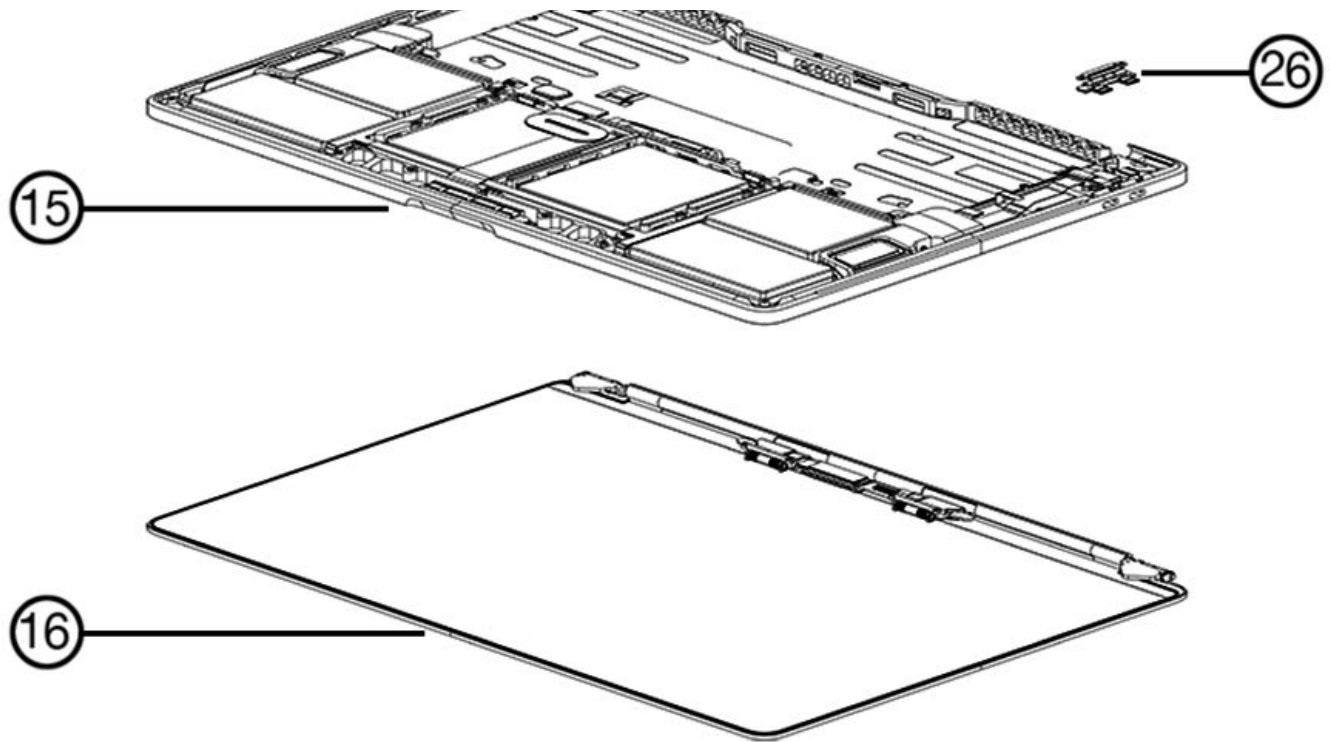
2. In AST 2, perform the Top Case to Logic Board Configuration Suite. This suite includes the Trackpad Calibration Check. For instructions on trackpad calibration, refer to article [TP1314: Trackpad Calibration Check](#).

3. Re-enable the auto boot features. Refer to article [TP1484: Auto Boot](#).

Exploded View

Exploded View for MacBook Pro (15-inch, 2016)





Note: Some part numbers are regionalized. They have the same part number, but include a language code prefix. For example, F661-05115 is for France. These include logic board and top case.

1. Bottom Case

- 923-01456, Space Gray
- 923-01457, Silver

2. Thermal Duct (pair)

- 923-01461

3. Cowling, Touch ID and Audio Board Flex

- 923-01488

4. Cowling, Trackpad Flex

- 923-01485

5. Cowling, Keyboard Flex

- 923-01486

6. Heat Sink

- 076-00294

7. BMU Mylar Cover

- 923-01465

8. Logic Board

- 661-06246, i7, 2.6GHz, 16GB, 256GB, Radeon Pro 450, FCC
- 661-06247, i7, 2.6GHz, 16GB, 256GB, Radeon Pro 450, ETSI
- 661-06248, i7, 2.6GHz, 16GB, 256GB, Radeon Pro 450, ROW
- 661-06250, i7, 2.6GHz, 16GB, 512GB, Radeon Pro 450, FCC
- 661-06251, i7, 2.6GHz, 16GB, 512GB, Radeon Pro 450, ETSI
- 661-06252, i7, 2.6GHz, 16GB, 512GB, Radeon Pro 450, ROW
- 661-06254, i7, 2.6GHz, 16GB, 1TB, Radeon Pro 450, FCC
- 661-06255, i7, 2.6GHz, 16GB, 1TB, Radeon Pro 450, ETSI
- 661-06256, i7, 2.6GHz, 16GB, 1TB, Radeon Pro 450, ROW
- 661-06258, i7, 2.6GHz, 16GB, 2TB, Radeon Pro 450, FCC
- 661-06259, i7, 2.6GHz, 16GB, 2TB, Radeon Pro 450, ETSI

- 661-06260, i7, 2.6GHz, 16GB, 2TB, Radeon Pro 450, ROW
- 661-06262, i7, 2.6GHz, 16GB, 256GB, Radeon Pro 460, FCC
- 661-06263, i7, 2.6GHz, 16GB, 256GB, Radeon Pro 460, ETSI
- 661-06264, i7, 2.6GHz, 16GB, 256GB, Radeon Pro 460, ROW
- 661-06266, i7, 2.6GHz, 16GB, 512GB, Radeon Pro 460, FCC
- 661-06267, i7, 2.6GHz, 16GB, 512GB, Radeon Pro 460, ETSI
- 661-06268, i7, 2.6GHz, 16GB, 512GB, Radeon Pro 460, ROW
- 661-06270, i7, 2.6GHz, 16GB, 1TB, Radeon Pro 460, FCC
- 661-06271, i7, 2.6GHz, 16GB, 1TB, Radeon Pro 460, ETSI
- 661-06272, i7, 2.6GHz, 16GB, 1TB, Radeon Pro 460, ROW
- 661-06274, i7, 2.6GHz, 16GB, 2TB, Radeon Pro 460, FCC
- 661-06275, i7, 2.6GHz, 16GB, 2TB, Radeon Pro 460, ETSI
- 661-06276, i7, 2.6GHz, 16GB, 2TB, Radeon Pro 460, ROW
- 661-06278, i7, 2.7GHz, 16GB, 512GB, Radeon Pro 455, FCC
- 661-06279, i7, 2.7GHz, 16GB, 512GB, Radeon Pro 455, ETSI
- 661-06280, i7, 2.7GHz, 16GB, 512GB, Radeon Pro 455, ROW
- 661-06282, i7, 2.7GHz, 16GB, 1TB, Radeon Pro 455, FCC
- 661-06283, i7, 2.7GHz, 16GB, 1TB, Radeon Pro 455, ETSI
- 661-06284, i7, 2.7GHz, 16GB, 1TB, Radeon Pro 455, ROW
- 661-06286, i7, 2.7GHz, 16GB, 2TB, Radeon Pro 455, FCC
- 661-06287, i7, 2.7GHz, 16GB, 2TB, Radeon Pro 455, ETSI
- 661-06288, i7, 2.7GHz, 16GB, 2TB, Radeon Pro 455, ROW
- 661-06290, i7, 2.7GHz, 16GB, 512GB, Radeon Pro 460, FCC
- 661-06291, i7, 2.7GHz, 16GB, 512GB, Radeon Pro 460, ETSI
- 661-06292, i7, 2.7GHz, 16GB, 512GB, Radeon Pro 460, ROW
- 661-06294, i7, 2.7GHz, 16GB, 1TB, Radeon Pro 460, FCC
- 661-06295, i7, 2.7GHz, 16GB, 1TB, Radeon Pro 460, ETSI
- 661-06296, i7, 2.7GHz, 16GB, 1TB, Radeon Pro 460, ROW
- 661-06298, i7, 2.7GHz, 16GB, 2TB, Radeon Pro 460, FCC
- 661-06299, i7, 2.7GHz, 16GB, 2TB, Radeon Pro 460, ETSI
- 661-06300, i7, 2.7GHz, 16GB, 2TB, Radeon Pro 460, ROW
- 661-06302, i7, 2.9GHz, 16GB, 256GB, Radeon Pro 450, FCC
- 661-06303, i7, 2.9GHz, 16GB, 256GB, Radeon Pro 450, ETSI
- 661-06304, i7, 2.9GHz, 16GB, 256GB, Radeon Pro 450, ROW
- 661-06306, i7, 2.9GHz, 16GB, 512GB, Radeon Pro 450, FCC
- 661-06307, i7, 2.9GHz, 16GB, 512GB, Radeon Pro 450, ETSI
- 661-06308, i7, 2.9GHz, 16GB, 512GB, Radeon Pro 450, ROW
- 661-06310, i7, 2.9GHz, 16GB, 1TB, Radeon Pro 450, FCC
- 661-06311, i7, 2.9GHz, 16GB, 1TB, Radeon Pro 450, ETSI
- 661-06312, i7, 2.9GHz, 16GB, 1TB, Radeon Pro 450, ROW
- 661-06314, i7, 2.9GHz, 16GB, 2TB, Radeon Pro 450, FCC
- 661-06315, i7, 2.9GHz, 16GB, 2TB, Radeon Pro 450, ETSI
- 661-06316, i7, 2.9GHz, 16GB, 2TB, Radeon Pro 450, ROW
- 661-06318, i7, 2.9GHz, 16GB, 512GB, Radeon Pro 455, FCC
- 661-06319, i7, 2.9GHz, 16GB, 512GB, Radeon Pro 455, ETSI
- 661-06320, i7, 2.9GHz, 16GB, 512GB, Radeon Pro 455, ROW
- 661-06322, i7, 2.9GHz, 16GB, 1TB, Radeon Pro 455, FCC
- 661-06323, i7, 2.9GHz, 16GB, 1TB, Radeon Pro 455, ETSI
- 661-06324, i7, 2.9GHz, 16GB, 1TB, Radeon Pro 455, ROW
- 661-06326, i7, 2.9GHz, 16GB, 2TB, Radeon Pro 455, FCC
- 661-06327, i7, 2.9GHz, 16GB, 2TB, Radeon Pro 455, ETSI
- 661-06328, i7, 2.9GHz, 16GB, 2TB, Radeon Pro 455, ROW
- 661-06330, i7, 2.9GHz, 16GB, 256GB, Radeon Pro 460, FCC
- 661-06331, i7, 2.9GHz, 16GB, 256GB, Radeon Pro 460, ETSI
- 661-06332, i7, 2.9GHz, 16GB, 256GB, Radeon Pro 460, ROW
- 661-06334, i7, 2.9GHz, 16GB, 512GB, Radeon Pro 460, FCC
- 661-06335, i7, 2.9GHz, 16GB, 512GB, Radeon Pro 460, ETSI
- 661-06336, i7, 2.9GHz, 16GB, 512GB, Radeon Pro 460, ROW
- 661-06338, i7, 2.9GHz, 16GB, 1TB, Radeon Pro 460, FCC
- 661-06339, i7, 2.9GHz, 16GB, 1TB, Radeon Pro 460, ETSI
- 661-06340, i7, 2.9GHz, 16GB, 1TB, Radeon Pro 460, ROW
- 661-06342, i7, 2.9GHz, 16GB, 2TB, Radeon Pro 460, FCC
- 661-06343, i7, 2.9GHz, 16GB, 2TB, Radeon Pro 460, ETSI
- 661-06344, i7, 2.9GHz, 16GB, 2TB, Radeon Pro 460, ROW

9. GPU Heat Sink Flexures

- 923-01483

10. Clutch Cover, Right

- 923-01463

11. I/O Board, Right

- 923-01480

12. Fan, Right

- 923-01471

13. Keyboard Flex Cable

- 923-01477, ANSI/ISO
- 923-01478, JIS

14. Touch ID

- Included with the logic board

15. Top Case with Battery (includes speakers, audio board, trackpad flex cable, microphone, trackpad, keyboard, Touch Bar flex cable, and Touch ID flex cable)

- 661-06377, Space Gray
- 661-06378, Silver

16. Display Assembly

- 661-06375, Space Gray
- 661-06376, Silver

17. Cowling, eDP (upper)

- 923-01310

18. Cowling, Touch Bar Touch

- 923-01490

19. Cowling, Touch Bar Display

- 923-01487

20. CPU Heat Sink Flexures

- 923-01484

21. Vent/Antenna Module

- 923-01460

22. Cowling, eDP (lower)

- 923-01489

23. eDP Flex Cable

- 923-01465

24. Fan, Left

- 923-01459

25. Clutch Cover, Left

- 923-01462

26. I/O Board, Left

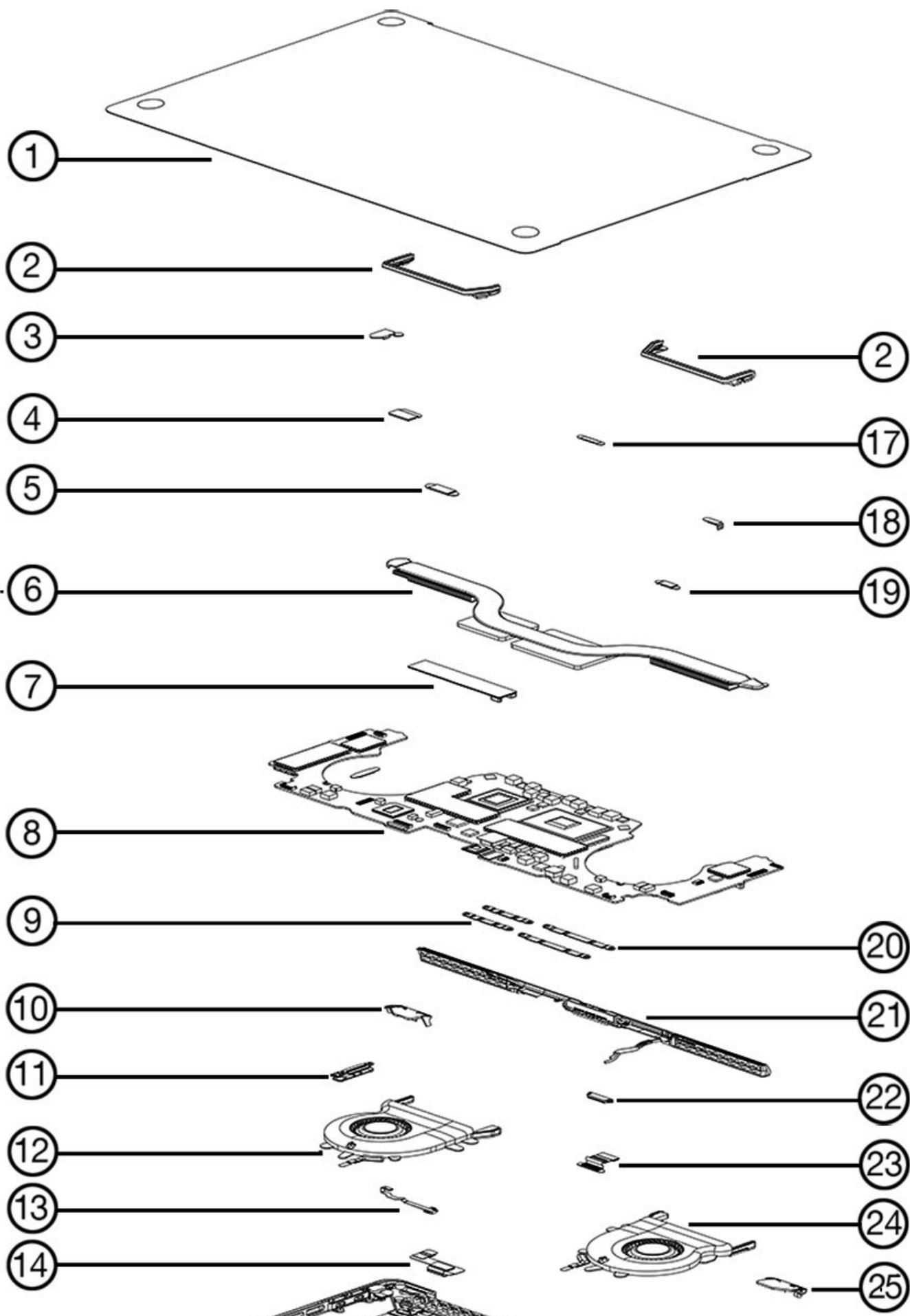
- 923-01480

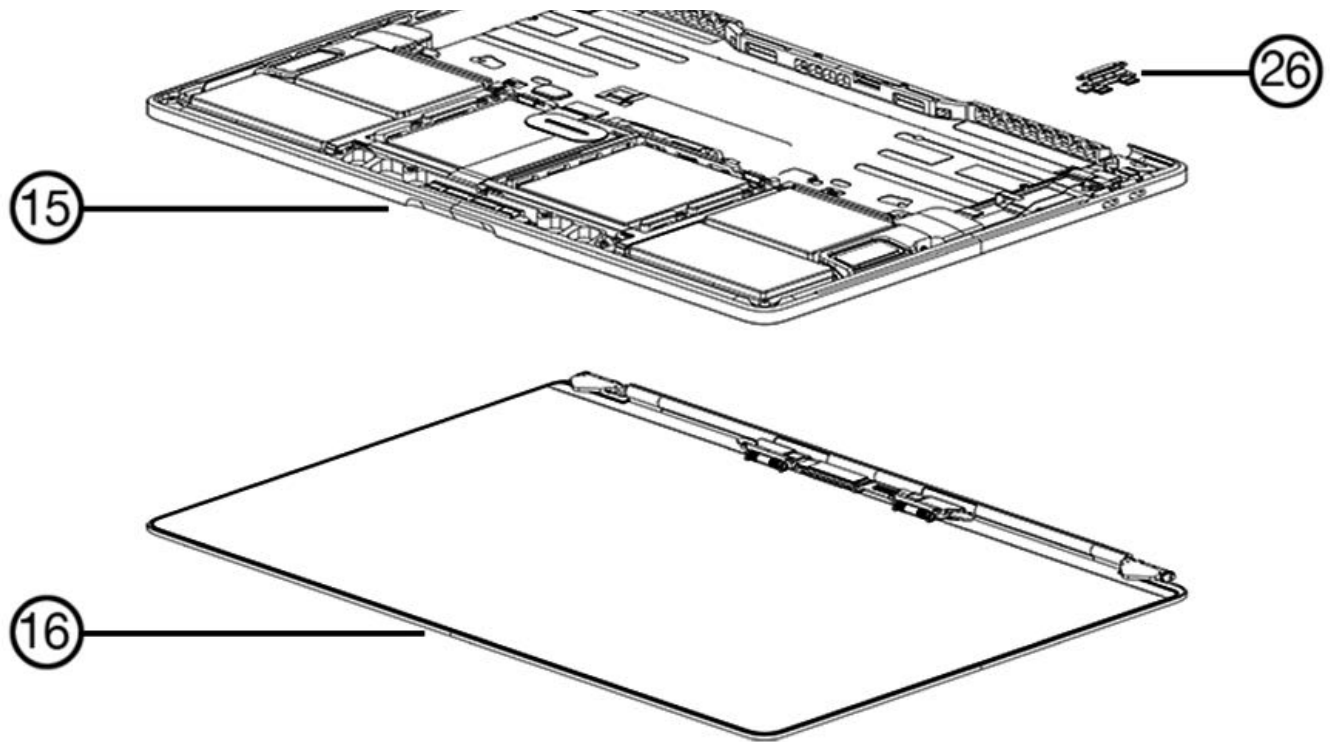
Not shown:

- Flexure, Touch ID, 3-pack, 923-01740

Exploded View

Exploded View for MacBook Pro (15-inch, 2017)





Note: Some part numbers are regionalized. They have the same part number, but include a language code prefix. For example, F661-05115 is for France. These include logic board and top case.

1. Bottom Case

- 923-01788, Space Gray
- 923-01789, Silver

2. Thermal Duct (pair)

- 923-01461

3. Cowling, Touch ID and Audio Board Flex

- 923-01488

4. Cowling, Trackpad Flex

- 923-01485

5. Cowling, Keyboard Flex

- 923-01486

6. Heat Sink

- 076-00294

7. BMU Mylar Cover

- 923-01465

8. Logic Board

- 661-07760, i7, 2.8GHZ, 16GB, 256GB, Radeon Pro 455, FCC
- 661-07761, i7, 2.8GHZ, 16GB, 256GB, Radeon Pro 455, ETSI
- 661-07762, i7, 2.8GHZ, 16GB, 256GB, Radeon Pro 455, ROW
- 661-07764, i7, 2.8GHZ, 16GB, 512GB, Radeon Pro 455, FCC
- 661-07765, i7, 2.8GHZ, 16GB, 512GB, Radeon Pro 455, ETSI
- 661-07766, i7, 2.8GHZ, 16GB, 512GB, Radeon Pro 455, ROW
- 661-07768, i7, 2.8GHZ, 16GB, 1TB, Radeon Pro 455, FCC
- 661-07769, i7, 2.8GHZ, 16GB, 1TB, Radeon Pro 455, ETSI
- 661-07770, i7, 2.8GHZ, 16GB, 1TB, Radeon Pro 455, ROW
- 661-07772, i7, 2.8GHZ, 16GB, 2TB, Radeon Pro 455, FCC
- 661-07773, i7, 2.8GHZ, 16GB, 2TB, Radeon Pro 455, ETSI

- 661-07774, i7, 2.8GHZ, 16GB, 2TB, Radeon Pro 455, ROW
- 661-07776, i7, 2.8GHZ, 16GB, 256GB, Radeon Pro 460, FCC
- 661-07777, i7, 2.8GHZ, 16GB, 256GB, Radeon Pro 460, ETSI
- 661-07778, i7, 2.8GHZ, 16GB, 256GB, Radeon Pro 460, ROW
- 661-07780, i7, 2.8GHZ, 16GB, 512GB, Radeon Pro 460, FCC
- 661-07781, i7, 2.8GHZ, 16GB, 512GB, Radeon Pro 460, ETSI
- 661-07782, i7, 2.8GHZ, 16GB, 512GB, Radeon Pro 460, ROW
- 661-07784, i7, 2.8GHZ, 16GB, 1TB, Radeon Pro 460, FCC
- 661-07785, i7, 2.8GHZ, 16GB, 1TB, Radeon Pro 460, ETSI
- 661-07786, i7, 2.8GHZ, 16GB, 1TB, Radeon Pro 460, ROW
- 661-07788, i7, 2.8GHZ, 16GB, 2TB, Radeon Pro 460, FCC
- 661-07789, i7, 2.8GHZ, 16GB, 2TB, Radeon Pro 460, ETSI
- 661-07790, i7, 2.8GHZ, 16GB, 2TB, Radeon Pro 460, ROW
- 661-07792, i7, 2.9GHZ, 16GB, 512GB, Radeon Pro 460, FCC
- 661-07793, i7, 2.9GHZ, 16GB, 512GB, Radeon Pro 460, ETSI
- 661-07794, i7, 2.9GHZ, 16GB, 512GB, Radeon Pro 460, ROW
- 661-07796, i7, 2.9GHZ, 16GB, 1TB, Radeon Pro 460, FCC
- 661-07797, i7, 2.9GHZ, 16GB, 1TB, Radeon Pro 460, ETSI
- 661-07798, i7, 2.9GHZ, 16GB, 1TB, Radeon Pro 460, ROW
- 661-07800, i7, 2.9GHZ, 16GB, 2TB, Radeon Pro 460, FCC
- 661-07801, i7, 2.9GHZ, 16GB, 2TB, Radeon Pro 460, ETSI
- 661-07802, i7, 2.9GHZ, 16GB, 2TB, Radeon Pro 460, ROW
- 661-07804, i7, 3.1GHZ, 16GB, 256GB, Radeon Pro 455, FCC
- 661-07805, i7, 3.1GHZ, 16GB, 256GB, Radeon Pro 455, ETSI
- 661-07806, i7, 3.1GHZ, 16GB, 256GB, Radeon Pro 455, ROW
- 661-07808, i7, 3.1GHZ, 16GB, 512GB, Radeon Pro 455, FCC
- 661-07809, i7, 3.1GHZ, 16GB, 512GB, Radeon Pro 455, ETSI
- 661-07810, i7, 3.1GHZ, 16GB, 512GB, Radeon Pro 455, ROW
- 661-07812, i7, 3.1GHZ, 16GB, 1TB, Radeon Pro 455, FCC
- 661-07813, i7, 3.1GHZ, 16GB, 1TB, Radeon Pro 455, ETSI
- 661-07814, i7, 3.1GHZ, 16GB, 1TB, Radeon Pro 455, ROW
- 661-07816, i7, 3.1GHZ, 16GB, 2TB, Radeon Pro 455, FCC
- 661-07817, i7, 3.1GHZ, 16GB, 2TB, Radeon Pro 455, ETSI
- 661-07818, i7, 3.1GHZ, 16GB, 2TB, Radeon Pro 455, ROW
- 661-07820, i7, 3.1GHZ, 16GB, 256GB, Radeon Pro 460, FCC
- 661-07821, i7, 3.1GHZ, 16GB, 256GB, Radeon Pro 460, ETSI
- 661-07822, i7, 3.1GHZ, 16GB, 256GB, Radeon Pro 460, ROW
- 661-07824, i7, 3.1GHZ, 16GB, 512GB, Radeon Pro 460, FCC
- 661-07825, i7, 3.1GHZ, 16GB, 512GB, Radeon Pro 460, ETSI
- 661-07826, i7, 3.1GHZ, 16GB, 512GB, Radeon Pro 460, ROW
- 661-07828, i7, 3.1GHZ, 16GB, 1TB, Radeon Pro 460, FCC
- 661-07829, i7, 3.1GHZ, 16GB, 1TB, Radeon Pro 460, ETSI
- 661-07830, i7, 3.1GHZ, 16GB, 1TB, Radeon Pro 460, ROW
- 661-07832, i7, 3.1GHZ, 16GB, 2TB, Radeon Pro 460, FCC
- 661-07833, i7, 3.1GHZ, 16GB, 2TB, Radeon Pro 460, ETSI
- 661-07834, i7, 3.1GHZ, 16GB, 2TB, Radeon Pro 460, ROW

9. GPU Heat Sink Flexures

- 923-01483

10. Clutch Cover, Right

- 923-01463

11. I/O Board, Right

- 923-01480

12. Fan, Right

- 923-01471

13. Keyboard Flex Cable

- 923-01477, ANSI/ISO
- 923-01478, JIS

14. Touch ID

- Included with the logic board

15. Top Case with Battery (includes speakers, audio board, trackpad flex cable, microphone, trackpad, keyboard, Touch Bar flex cable, and Touch ID flex cable)

- 661-07954, Space Gray
- 661-07955, Silver

16. Display Assembly

- 661-08030, Space Gray
- 661-08031, Silver

17. Cowling, eDP (upper)

- 923-01310

18. Cowling, Touch Bar Touch

- 923-01490

19. Cowling, Touch Bar Display

- 923-01487

20. CPU Heat Sink Flexures

- 923-01484

21. Vent/Antenna Module

- 923-01460

22. Cowling, eDP (lower)

- 923-01489

23. eDP Flex Cable

- 923-01465

24. Fan, Left

- 923-01459

25. Clutch Cover, Left

- 923-01462

26. I/O Board, Left
















- 923-01480


Not shown:

- Flexure, Touch ID, 3-pack, 923-01740

Screw Chart

Screw Chart for MacBook Pro (15-inch, 2016 and 2017)

<p>923-01516, Silver Pentalobe</p>  <p>Bottom Case, Lower (2)</p>	<p>923-01517, Silver Pentalobe</p>  <p>Bottom Case, Upper Corners, (2)</p>	<p>923-01513, Space Gray Pentalobe</p>  <p>Bottom Case, Lower (2)</p>
<p>923-01514, Space Gray Pentalobe</p>  <p>Bottom Case, Upper Corners, (2)</p>	<p>923-01418 Torx T5</p>  <p>BMU Screw (1)</p>	<p>923-01185 Torx T3</p>  <p>Spring Tensioners (4)</p>
<p>923-01286 Torx T3</p>  <p>Display Clutch Covers (4)</p>	<p>923-01173 Torx T8</p>  <p>Display Assembly Hinge (6)</p>	<p>923-01512 1IPR</p>  <p>Vent/Antenna Module (16)</p>
<p>923-01497 Torx T3</p>  <p>Logic Board (2)</p>	<p>923-01423 Torx T3</p>  <p>Fans (Left and Right) (6)</p>	<p>923-01498 Torx T5</p>  <p>Logic Board (1)</p>
<p>923-01190 Torx T3</p>  <p>eDP Flex Cable to Logic Board (2)</p>	<p>923-01285 Torx T3</p>  <p>eDP Flex Cable Upper Cowling (2) TCON Cowling (4)</p>	<p>923-01510 Torx T3</p>  <p>eDP Flex Cable Lower Cowling (2)</p>

<p>923-01277 Torx T5</p>  <p>TCON Board Screws (4)</p>	<p>923-01505 Torx T8</p>  <p>Heat Sink, Right</p>	<p>923-01502 Torx T8</p>  <p>Heat Sink, Left</p>
<p>923-01507 Torx T5</p>  <p>Heat Sink Flexures GPU (4)</p>	<p>923-01508 Torx T5</p>  <p>Heat Sink Flexures CPU (4)</p>	<p>923-01506 Torx T3</p>  <p>Touch ID and Audio Board Flex Cowling (2)</p>
<p>923-01442 Torx T3</p>  <p>Touch ID (2)</p>	<p>923-01443 Torx T3</p>  <p>Touch ID (4)</p>	<p>923-01501 Torx T3</p>  <p>Trackpad Flex Cowling Keyboard Flex Cowling Touch Bar Display Flex Cowling</p>
<p>923-01411 Torx 3</p>  <p>Touch Bar Touch Flex Cowling I/O Board Cowling Customer Data Migration Connector</p>	<p>923-01515 Torx T3</p>  <p>Fans (Left and Right) (2)</p>	<p>923-01509 Torx T5</p>  <p>I/O Board (Left and Right) (4)</p>
<p>923-01464 Hex driver</p>  <p>Logic Board Standoff</p>		

Screw Location Diagrams

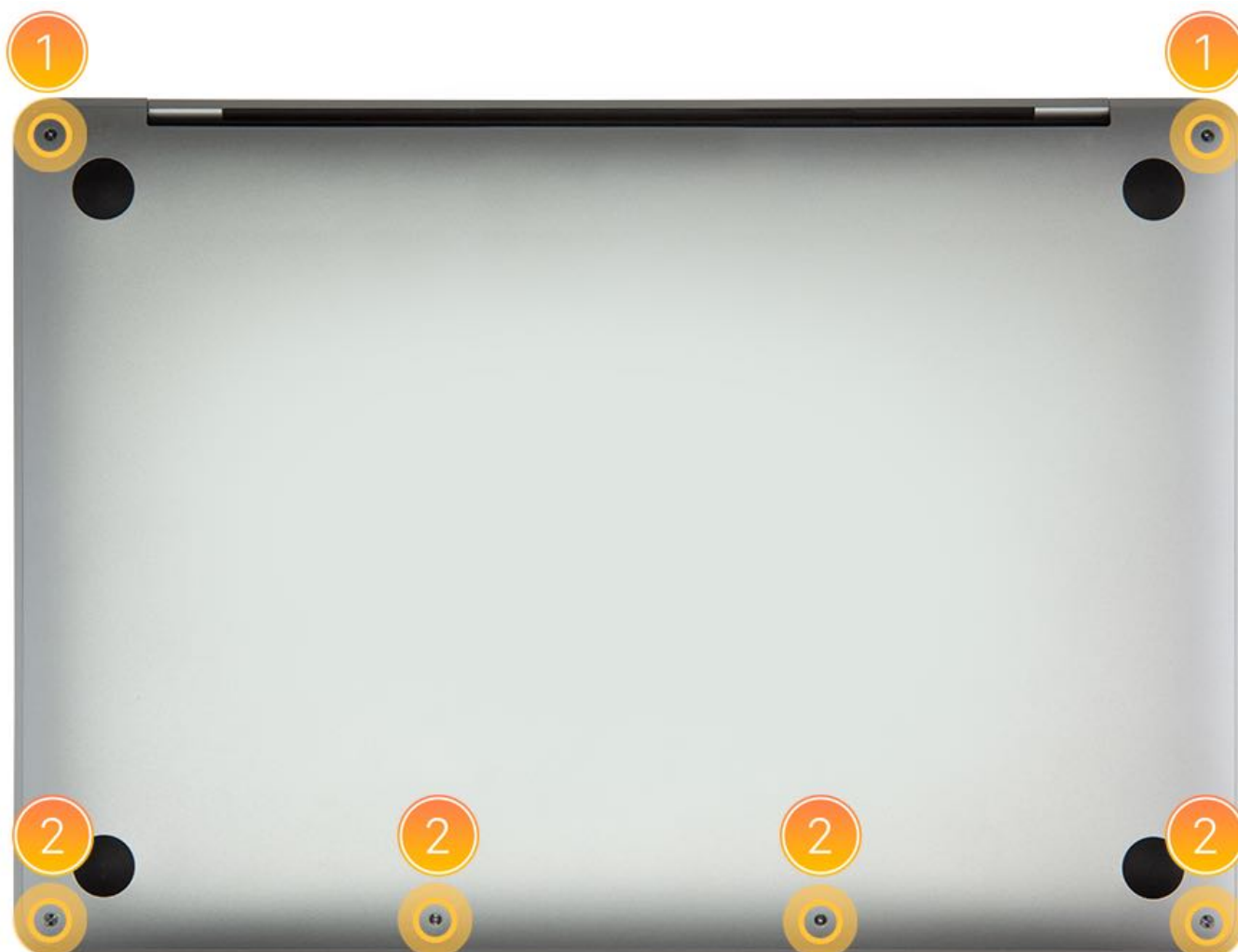
Screw Location Diagrams for MacBook Pro (15-inch, 2016 and 2017)

Bottom Case

- Pentalobe: (position 1)
 - 923-01517 Silver
 - 923-01514 Space Gray

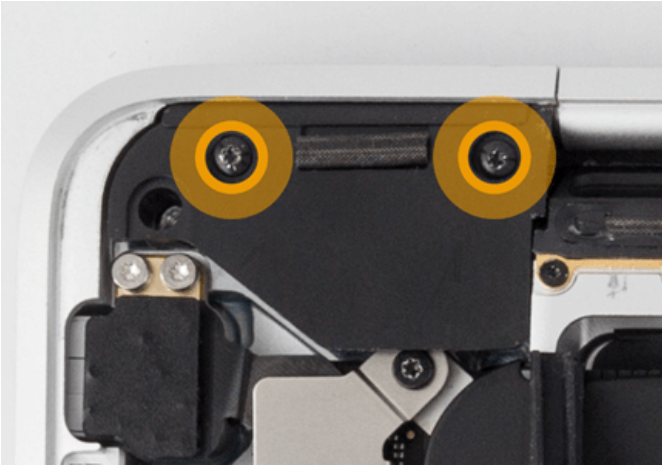


- Pentalobe: (position 2)
 - 923-01516 Silver
 - 923-01513 Space Gray



Clutch Covers

- T3: 923-01286

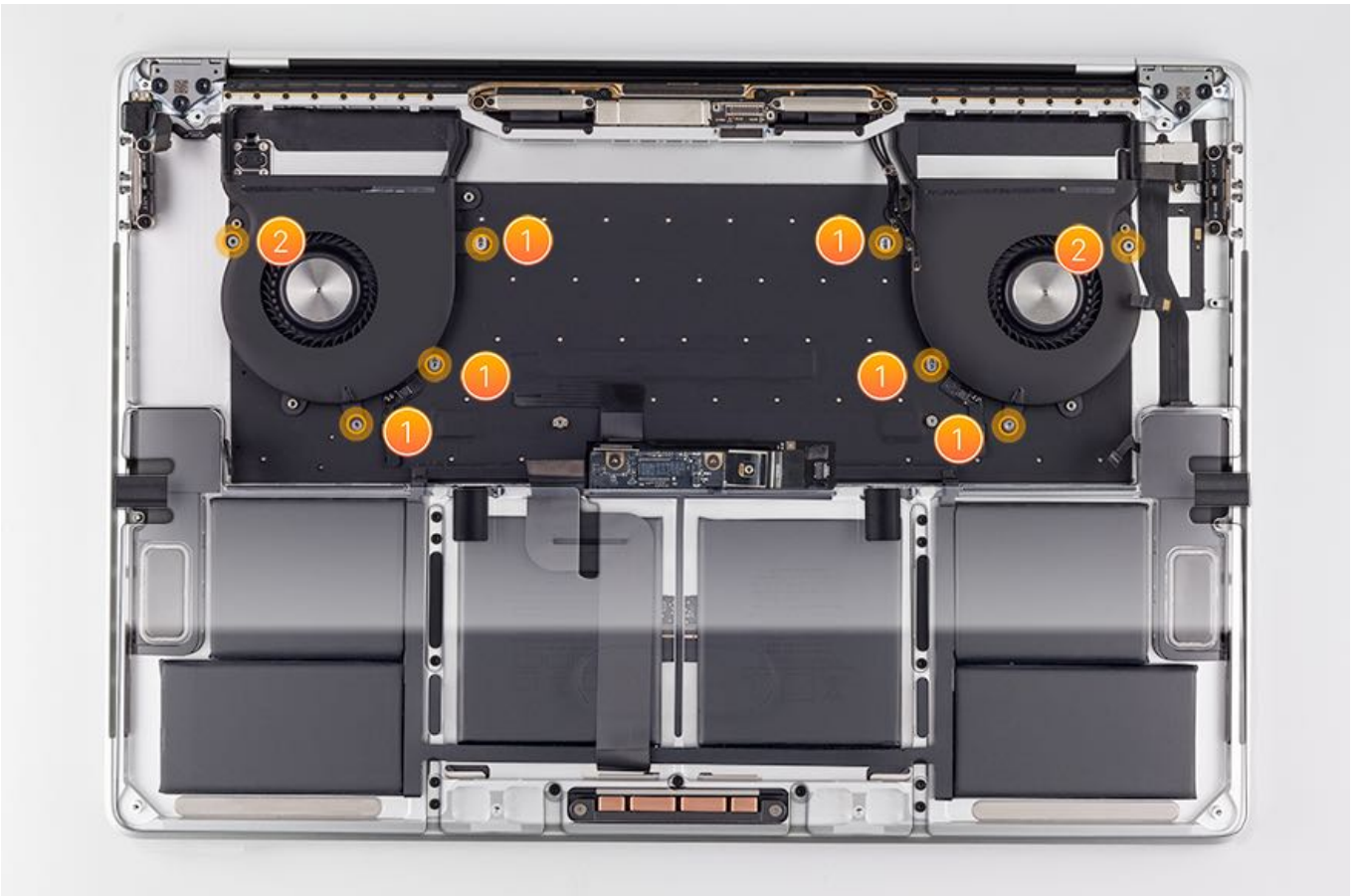


Right and Left Fans

- T3: 923-01423 (position 1)



- T3: 923-01515 (position 2)



Logic Board Cowling Screws

1. Touch Bar Touch
2. Left I/O Board
6. Customer Data Migration Tool Connector
7. Right I/O Board

- T3: 923-01411



3. Touch Bar Display
4. Keyboard Flex
5. Trackpad Flex

- T3: 923-01501



8. Touch ID and Audio Board

- T3: 923-01506



9. Lower eDP flex cable cowling

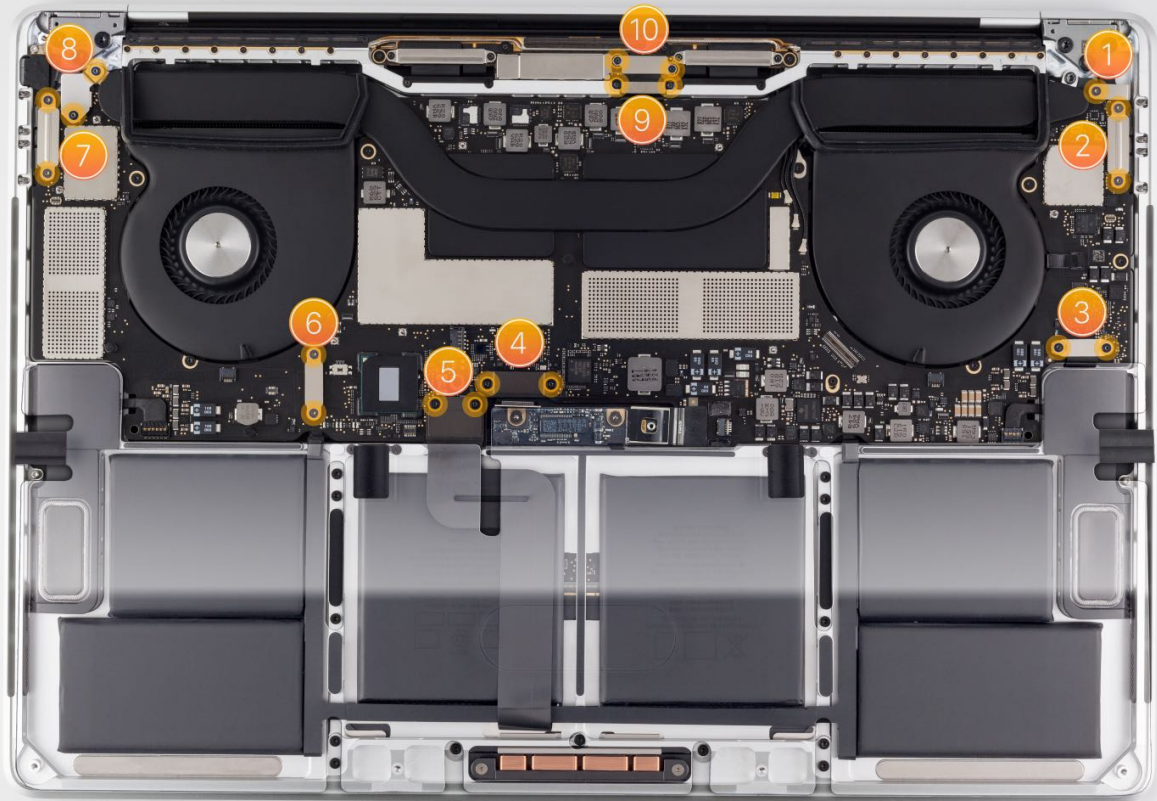
- T3: 923-01510



10. Upper eDP flex cable cowling

- T3: 923-01285





Logic Board Screws

- T5: (position 1)
 - 923-01500

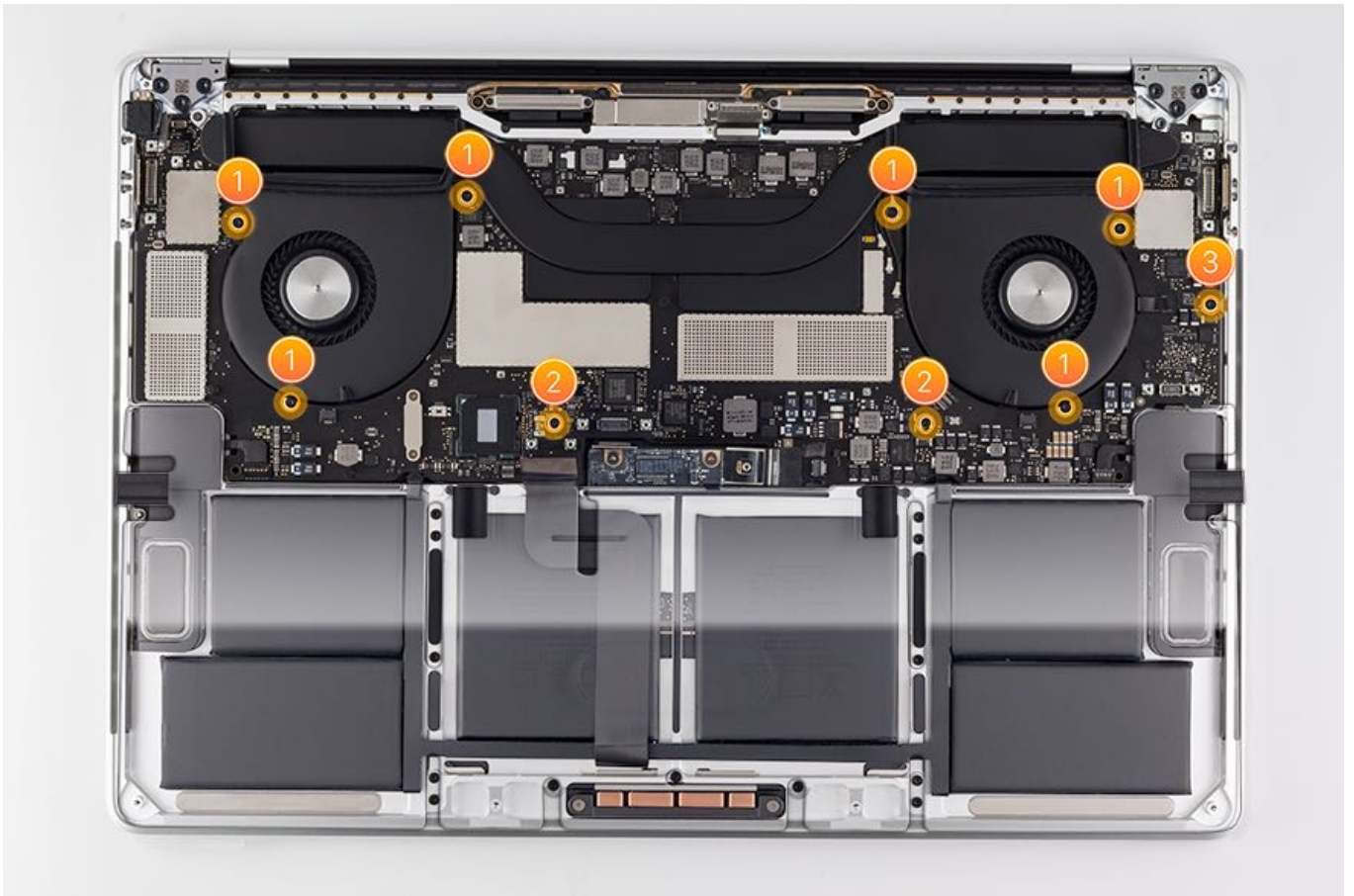


- T3: (position 2)
 - 923-01497



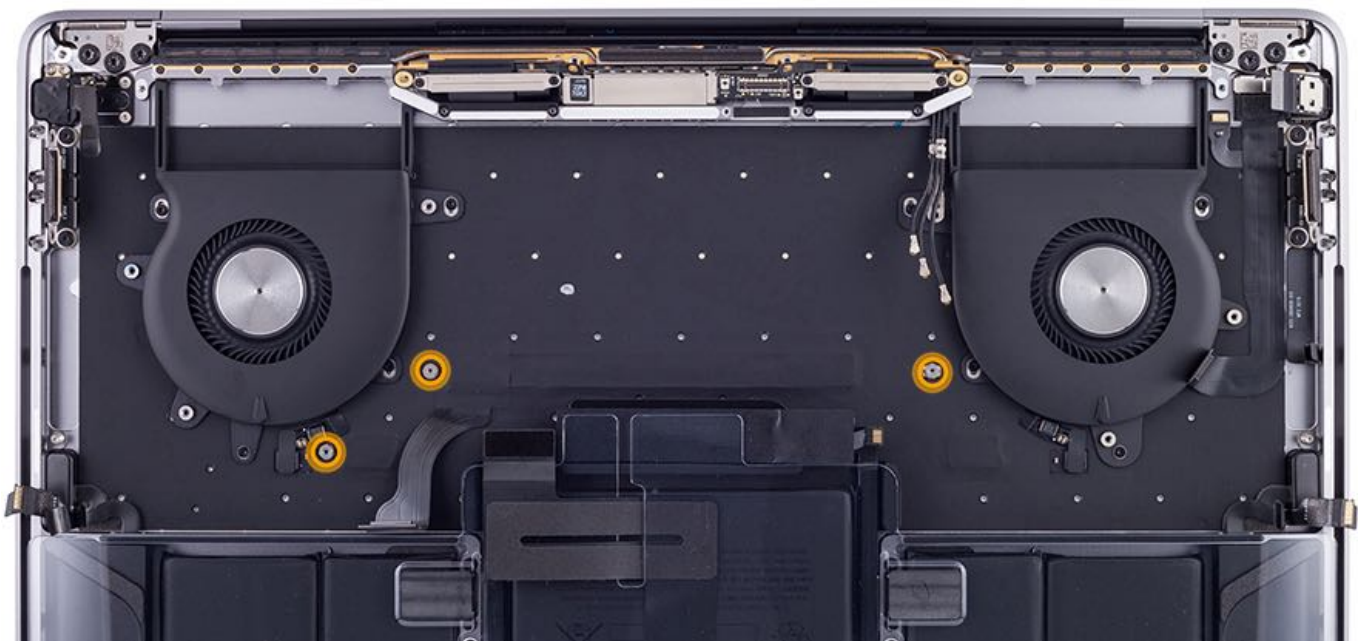
- T5: (position 3)
 - 923-01498





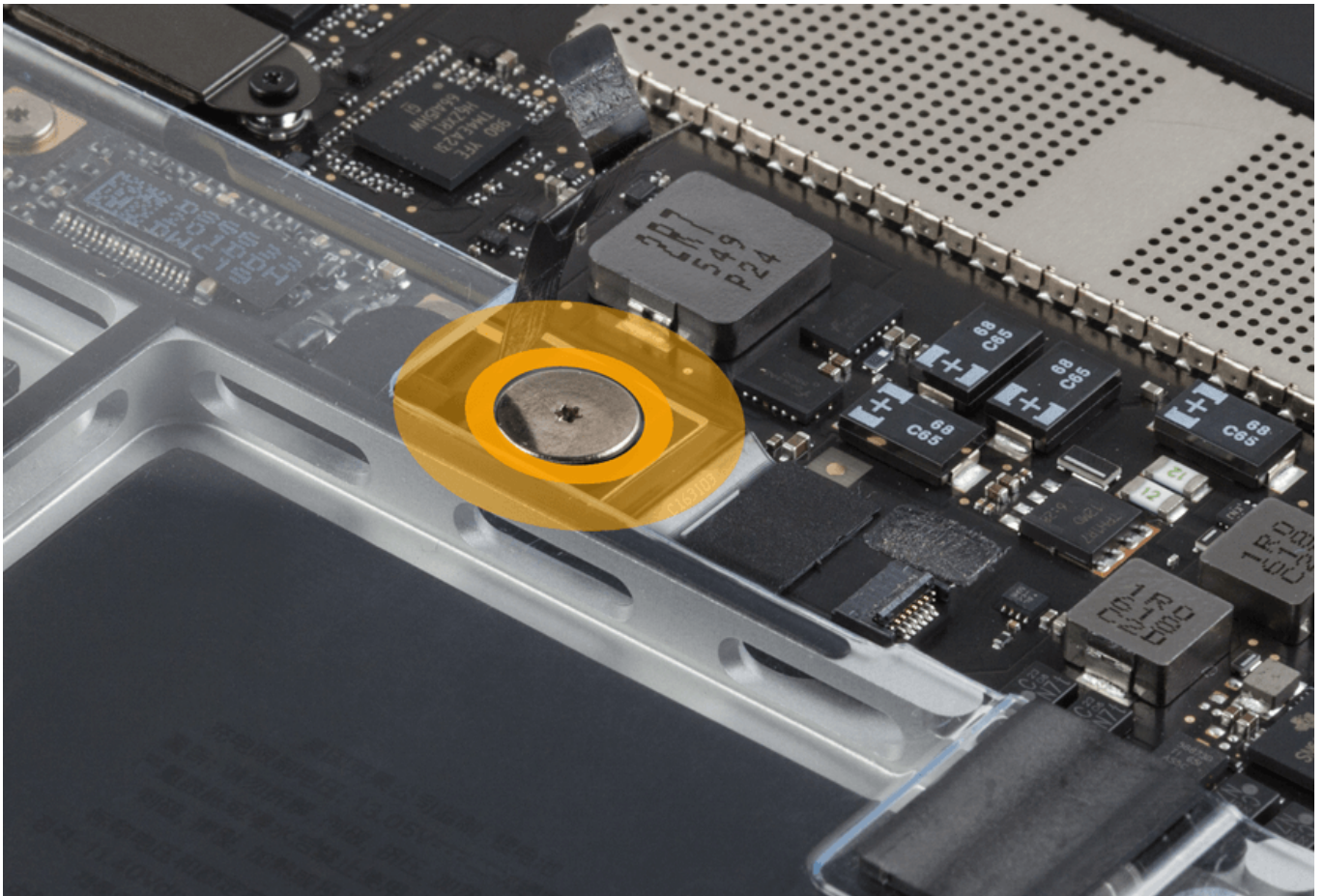
Logic Board Standoffs

- Hex Driver: 923-01464



BMU

- T5: 923-01418

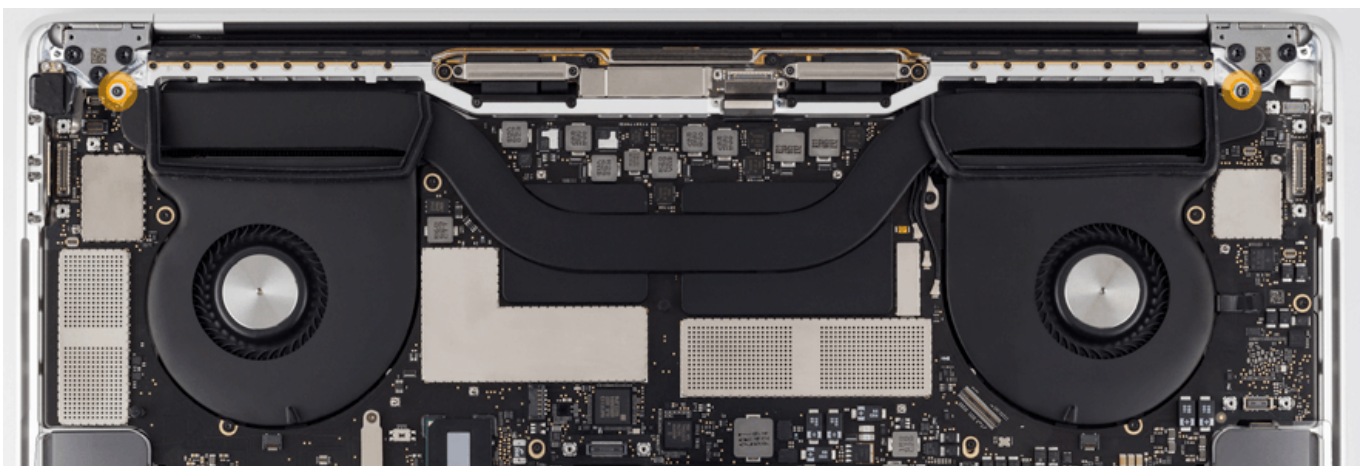


Heat Sink

- T8: 923-01505 (right)

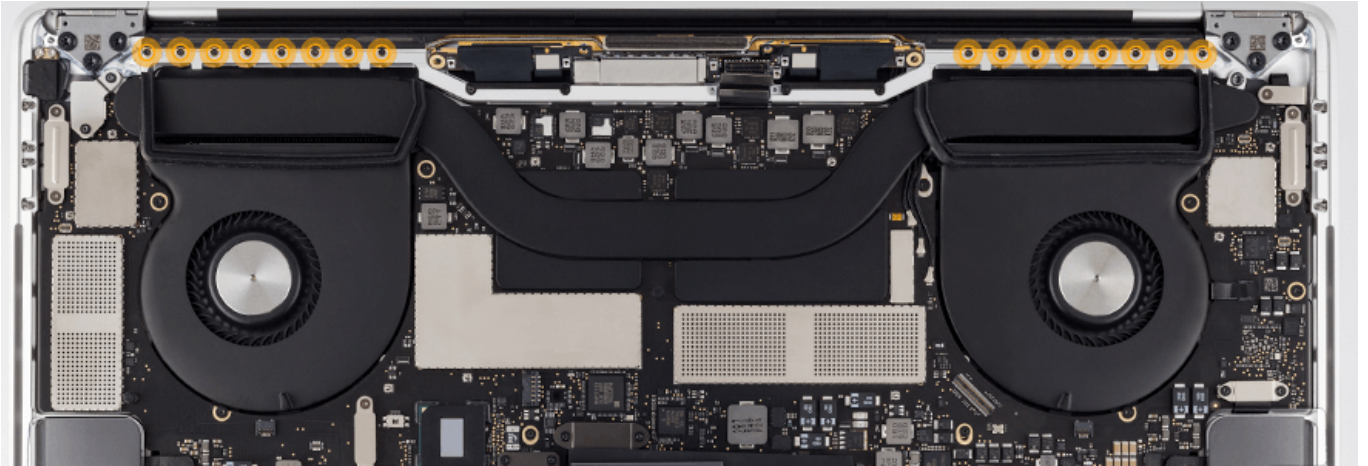


- T8: 923-01502 (left) **Note:** The left screw is a screw within a screw.



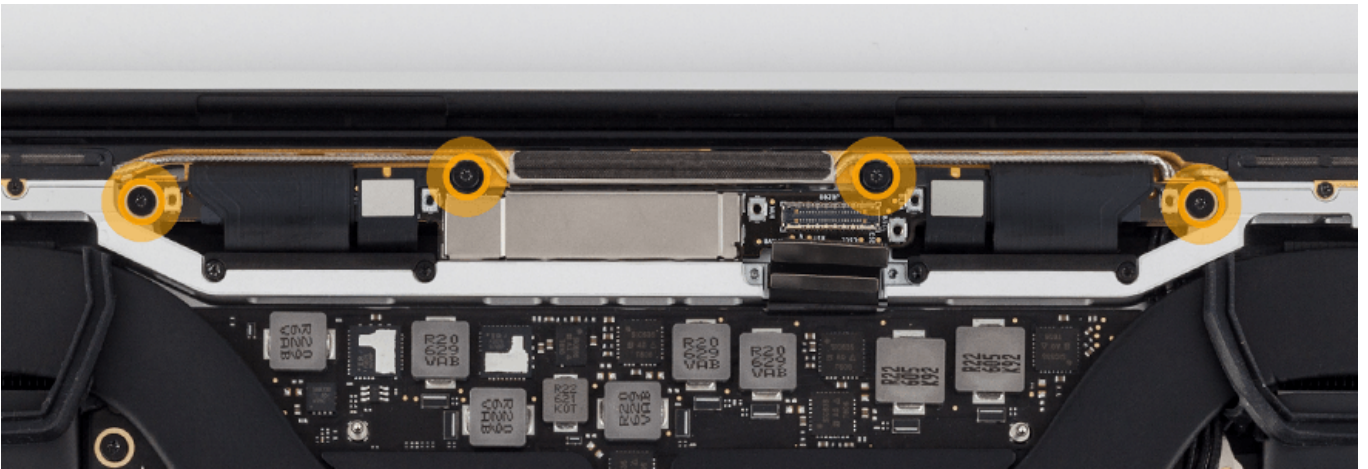
Vent/Antenna Module

- 1IPR: 923-01512



TCON Board

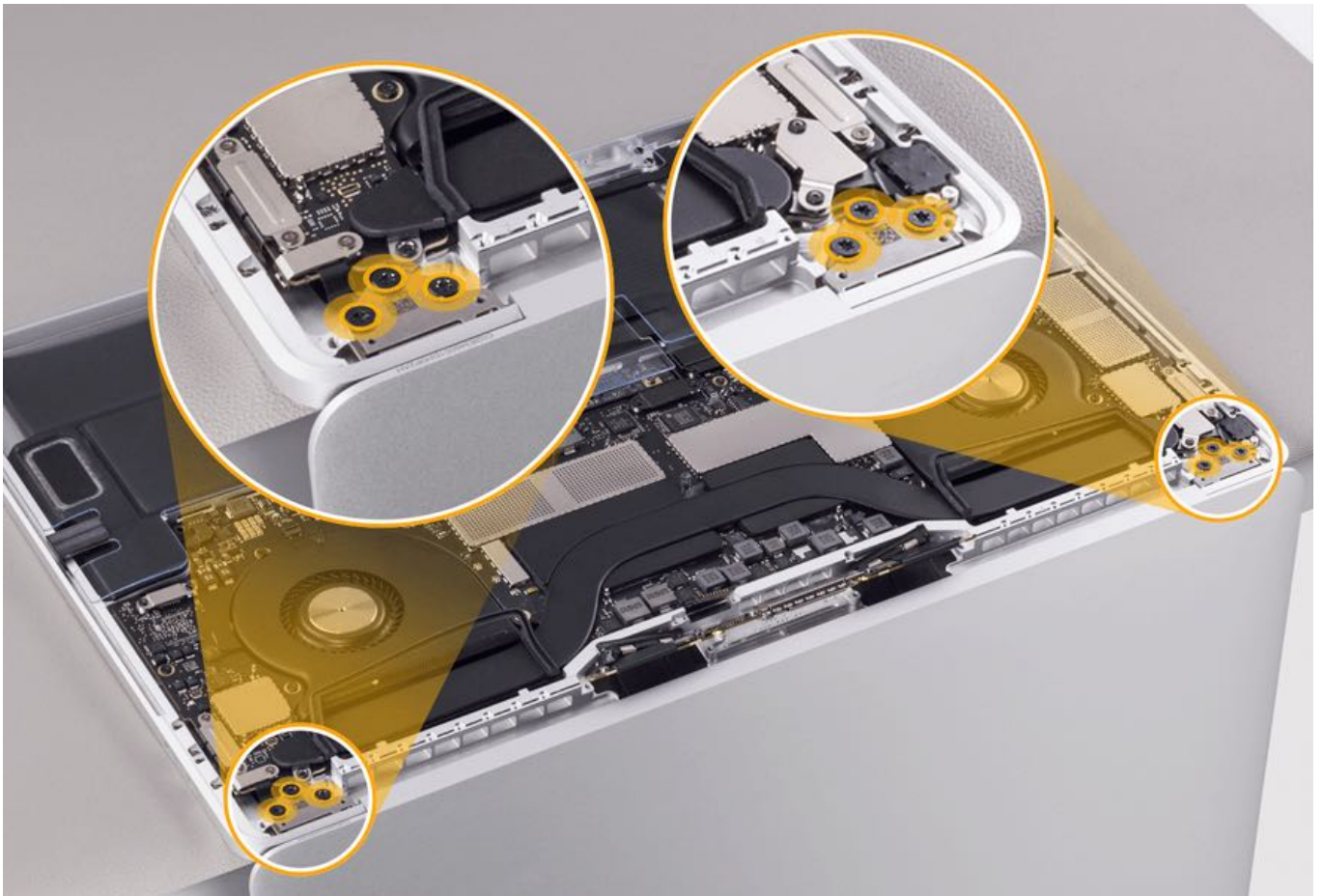
- T5: 923-01277



Display Hinge Screws

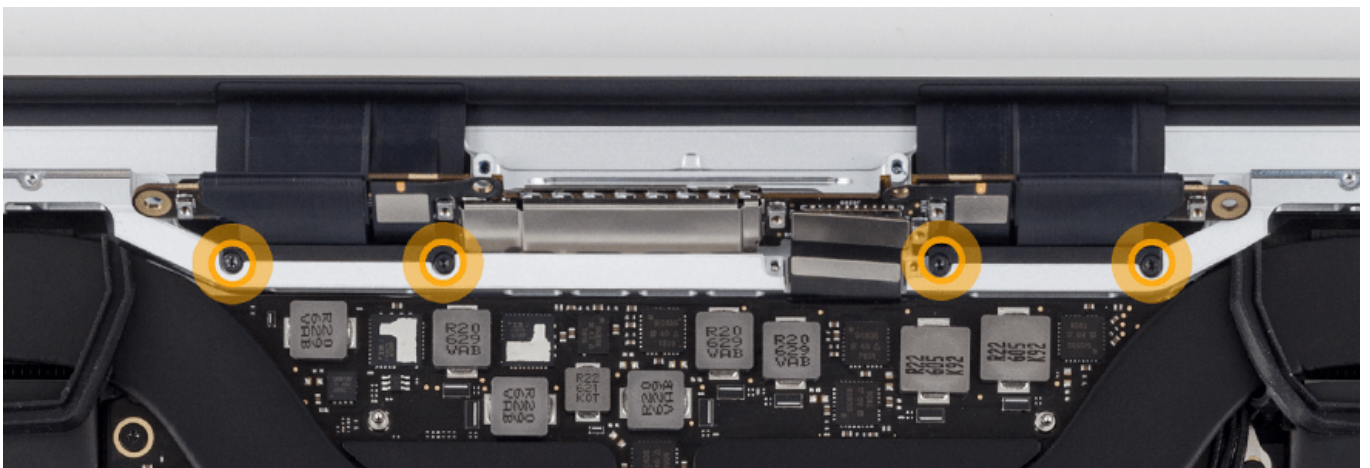
- T8: 923-01173





Spring Tensioners

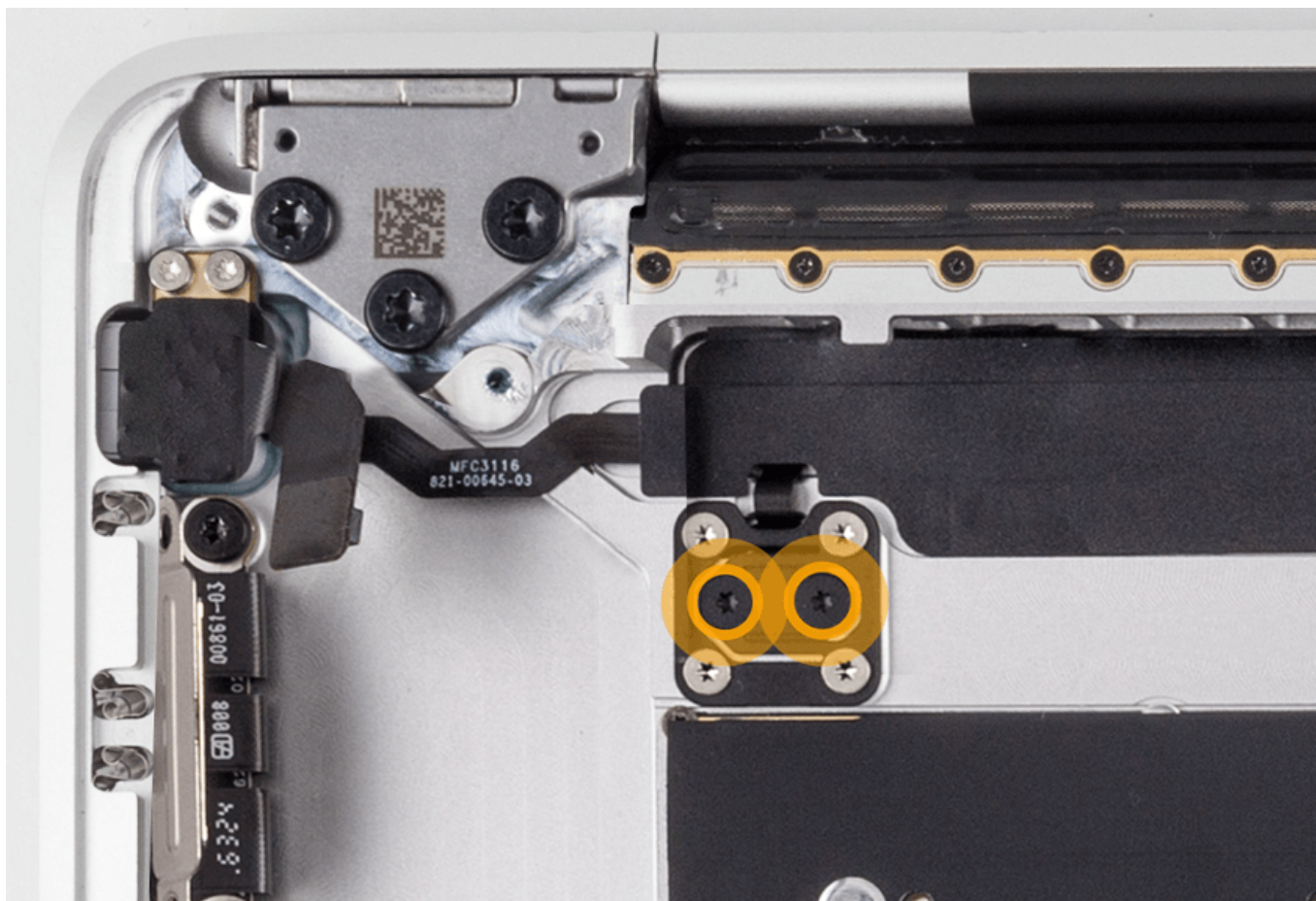
- T3: 923-01185



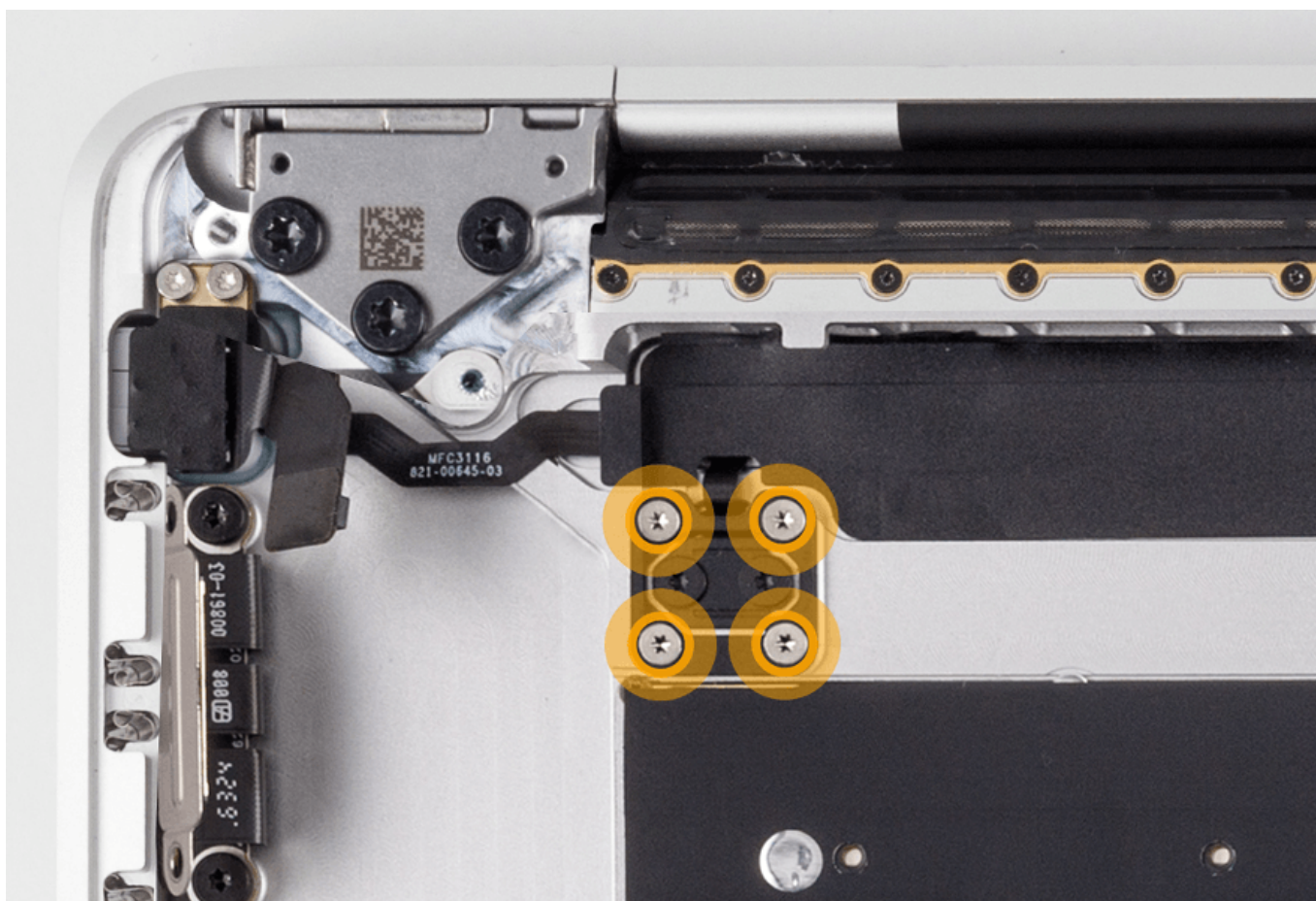
Touch ID

- T3: 923-01442





- T3: 923-01443



External Views

External Views for the following models:

- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports)
- MacBook Pro (15-inch, 2016 and 2017)

Port Views



A = Headphone Jack

B = Four Thunderbolt 3 Ports

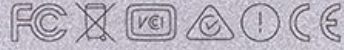
Bottom Case View

You can identify models by the model number on the bottom case.

Note: The image below shows the MacBook Pro (13-inch, 2016, Two Thunderbolt 3 Ports) model number location. The model number is in the same location for the products mentioned below.

- MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): **A1706**
- MacBook Pro (15-inch, 2016 and 2017): **A1707**

Designed by Apple in California. Assembled in China. Model A1708 EMC 2978 Rated 20.3V= 3.0A max.
FCC ID: BCGA1708 and IC: 579C-A1708 CAN ICES-3 (B)/NMB-3(B) Serial

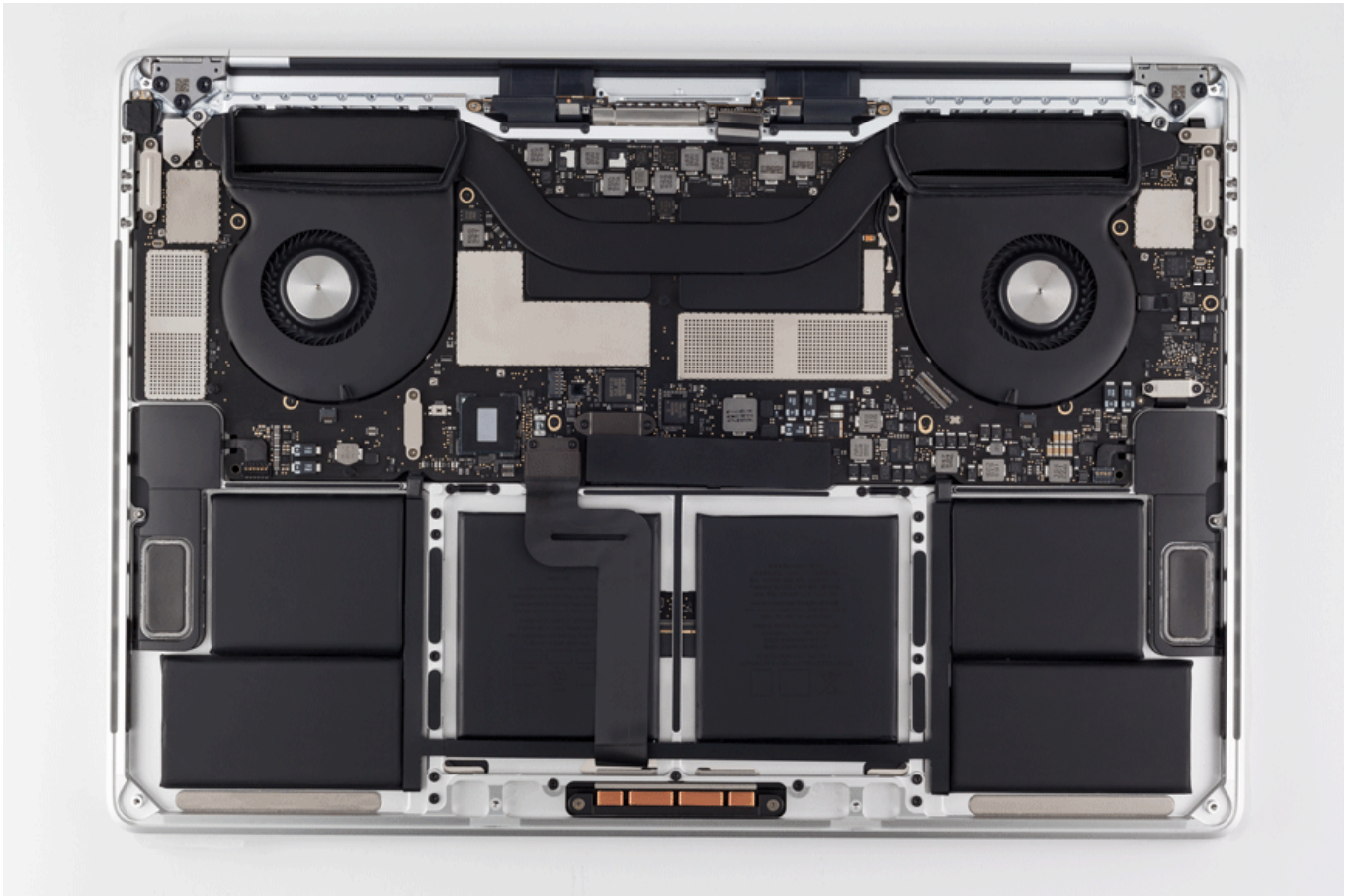


Designed by Apple in California. Assembled in China. Model A1708 EMC 2978 Rated 20.3V= 3.0A max.
FCC ID: BCGA1708 and IC: 579C-A1708 CAN ICES-3 (B)/NMB-3(B) Serial



Internal Views

Internal View for MacBook Pro (15-inch, 2016 and 2017)



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